The City of Canton

Invitation to Bid

City of Canton, Ohio

Purchasing Department
218 Cleveland Ave. SW, 4th floor
Canton, Ohio 44702

Sugar Creek Water Treatment Plant & Wellfield Improvements

Item/Project

Water Department - This project is contingent upon the City receiving funds from OEPA WSRLA.

Responsible Department

2:00:00 PM, 6/1/2022

Bids Due

Bid Proposal Submitted By:

Company Name

Street Address

City **State** **Zip**

Contact Person **Phone No.** **Email Address**

The City of Canton

Table of Contents and Bidder's Checklist - Sugar Creek Water Treatment Plant & Wellfield Improvements

Bidder's Checklist: The completed Bid Form shall be accompanied by the following completed documents:

_____ **Pre-Bid Substitution, if any proposed substitutes have been pre-approved.**
_____ **Bid Guaranty and, if applicable Contract Bond**
_____ **Contractor's Qualification Statement**
_____ **Contractor's List of Subcontracted Work Categories**
_____ **A list identifying its DBE subcontractors and participation rates as a percentage of the Contract Price, and if the DBE participation goal has not been met, certification of good faith efforts to meet the DBE participation goal.**
_____ **The Project Labor Agreement (PLA) Letter of Assent (See Appendix A).**
_____ **If this project is funded in whole or part by the Ohio Public Works Commission, then certification of agreement and compliance with certain statements and covenants regarding Bidder's subscription to the State's Equal Employment Opportunity Requirements for State-assisted Construction Contracts.**
****Ohio Public Works Commission Funding does not apply to the project. However, Water Supply Revolving Loan Account (WSRLA) administered by the Ohio Water Development Authority (OWDA) does and therefore Appendix C provides guidance concerning the requirements thereof.****
_____ **Manufacturers of Material and Equipment to be Furnished**
_____ **Bid Schedule Proposal Pages and Signature Pages at end of bid packet**

The City of Canton

Legal Notice

Sealed bids will be received by the City of Canton (the "City"), as provided in this notice for the Sugar Creek Water Treatment Plant & Wellfield Improvements Project (the "Project"), Ordinance 11/2022. Contract documents, which include additional details of the Project, are on file and available from the City of Canton's web site (https://cantonohio.gov/448/Purchasing-Procurement).

Bids shall be enclosed in a sealed envelope addressed to the City of Canton, 218 Cleveland Ave. SW, Purchasing Dept/Fourth Floor, Canton, Ohio 44702 and plainly marked on the outside "Sugar Creek Water Treatment Plant & Wellfield Improvements PROJECT BID." Bids will be received on or before 2:00 PM, local time, 6/1/2022 and opened shortly thereafter.

Questions regarding plans and specifications should be addressed in writing to Purchasing Department, at purchasing@cantonohio.gov.

All bids must include a Bid Guaranty, as described in the Instructions to Bidders. Prevailing wage rates apply. All bidders will be required to comply with the City Contract Compliance Program regarding equal employment opportunity. After submission and opening, no bidder may withdraw its bid within 60 days after the opening; the City reserves the right to waive irregularities, reject any or all bids, and conduct necessary investigations to determine bidder responsibility.

This procurement is subject to the EPA policy of encouraging the participation of small business in rural areas (SBRAs).

The successful bidder must comply with all Davis-Bacon Prevailing Wage Rates.

All companies must submit their Federal ID Number.

A Project Labor Agreement (PLA) is required for this project.

The Engineer's Estimate for the base bid is $30,243,000.00. This project is contingent upon the City receiving funding.

The bidder is responsible for monitoring the City's website for any official addenda.

Published in The Repository on Tuesday, April 26 and May 3rd, 2022

INSTRUCTIONS TO BIDDERS

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A. BIDDER'S PLEDGE AND AGREEMENT

1. Each Bidder acknowledges that this is a public project involving public funds and that the Owner expects and requires that each successful Bidder adhere to the highest ethical and performance standards. Each Bidder by submitting a bid pledges and agrees that (a) it will act at all times with absolute integrity and truthfulness in its dealings with the Owner and the Engineer, (b) it will use its best efforts to cooperate with the Owner and the Engineer and all other Contractors on the Project and at all times will act with professionalism and dignity in its dealings with the Owner, Engineer, and other Contractors, (c) it will assign only competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks that are assigned to him/her, and (d) it has read, understands and will comply with the terms of the Contract Documents.

B. EXAMINATION OF CONTRACT DOCUMENTS AND SITE CONDITIONS AND RELIANCE UPON TECHNICAL DATA

1. Each Bidder shall have a competent person carefully and diligently review each part of the Contract Documents, including the Divisions of the Specifications and parts of the Drawings that are not directly applicable to the Work on which the Bidder is submitting its bid. By submitting its bid, each Bidder represents and agrees, based upon its careful and diligent review of the Contract Documents, that it is not aware of any conflicts, inconsistencies, errors, or omissions in the Contract Documents for which it has not notified the Owner in writing at least ten (10) days prior to the bid opening. If there are any such conflicts, inconsistencies, errors, or omissions in the Contract Documents, the Bidder (i) will provide the labor, equipment, or materials of the better quality or greater quantity of Work and/or (ii) will comply with the more stringent requirements. The Bidder will not be entitled to any Change Order, additional compensation, or additional time on account of such conditions for any conflicts, inconsistencies, errors, or omissions that would have been discovered by such careful and diligent review, unless it has given prior written notice to the Owner.

2. Each Bidder shall have a competent person carefully and diligently inspect and examine the entire site and the surrounding area, including all parts of the site applicable to the Work for which it is submitting its bid, including location, condition, and layout of the site and the location of utilities, and carefully correlate the results of the inspection with the requirements of the Contract Documents. The Bidder's bid shall include all costs attributable to site and surrounding area conditions that would have been discovered by such careful and diligent inspection and examination of the site and the surrounding area, and the Bidder shall not be entitled to any Change Order, additional compensation, or additional time on account of such conditions.

3. The Bidder may rely upon the general accuracy of any technical data identified in the Owner-Contractor Agreement (e.g., any soils exploration reports, soil boring logs, site survey, or abatement reports) in preparing its bid, but such technical data are not part of the Contract Documents. Except for the limited reliance described in the preceding sentence, Bidder may not, if awarded a contract for the Work, rely upon or make any Claim against the Owner or Engineer, or any of their agents or employees, with respect to any of the following:

    a. the completeness of such reports and drawings for Bidder's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by the successful Bidder and safety precautions and programs incident thereto; or

b. any interpretation by the successful Bidder of or conclusion drawn from any technical data or any such other data, interpretations, opinions, or information. For example, all interpolations and extrapolations of data performed by the Bidder to estimate locations or quantities of subsurface strata are independent factual assumptions, which Owner does not warrant.

4. Each Bidder will be deemed to have actual knowledge of all information provided or discussed at the pre-bid meeting.

C. OWNER & ENGINEER

1. The Owner is:

The City of Canton
218 Cleveland Avenue SW
Canton, OH 44702
Telephone: 330.489.3245
Fax: 330.489.3499

The Owner's Representative is:

Brent Burrier

2. The Design Engineer for the Project is:

Burgess & Niple, Inc.
100 West Erie Street
Painesville, Ohio 44077

D. PROJECT

1. The Project and Work for the Project consists of all labor, materials, equipment, and services necessary for construction of the project identified as **Sugar Creek Water Treatment Plant & Wellfield Improvements Project** ("the Project"), all in accordance with the Drawings and Specifications prepared by the Engineer and/or Owner. The Project must be substantially complete by the Date for Substantial Completion set forth in Section Q below.

2. The Mayor **has** determined that a Project Labor Agreement ("PLA") will advance the City's procurement interest in cost, efficiency, and quality while promoting labor-management stability as well as compliance with applicable legal requirements governing safety and health, equal employment opportunity, labor and employment standards, and other related matters. Any such PLA shall be negotiated by the Mayor of the Owner with the East Central Ohio Building and Construction Trades Council and its affiliated local unions, or said Council's successor. The successful Bidder shall comply with and adhere to all of the provisions of any PLA for the Project.

3. A pre-bid conference will be held at **1:00 PM on May 05, 2022** at **the Sugar Creek Water Treatment Plant (Google address is 9649 Dolphin Street SW, Beach City, OH)**.

E. WORK

1. This Project includes **Site work, roadwork, asphalt, concrete, new buildings, waterwork, HVAC, plumbing, electrical, mechanical, chemical feed systems**, and the like as set forth in the Contract Documents.

2. Alternate No. 1 for this Project is **Additional time for Owner to execute Owner-Contractor Agreement**.

3. Alternate No. 2 for this Project is **Canton NW Water Treatment Plant ATI filtersmart controller system**.

4. Alternate No. 3 for this Project is **Canton NE Water Treatment Plant ATI filtersmart controller system.**

5. Alternate No. 4 for this Project is **18" through 42" PCCP C301 SP-5 finished water distribution main repair kits.**

6. Alternate No. 5 for this Project is **Painting of Filter Pipe Gallery (Room, 108, 108A & 108B), Connected Hallways and Stairwell E & F.**

7. Alternate No. 6 for this Project is **Roof Replacements.**

8. Only one contract will be issued by the Owner for constructing the Project, the General Contract, which will cover all scopes of work necessary to construct the Project.

9. The Contractor awarded the General Contract (General Contractor) will be responsible for the performance and coordination of any and all subcontractors and suppliers either directly or indirectly contracted with the General Contractor.

10. Owner will provide Bidders access to the Project site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up, and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable laws, regulations and Owner's policies relative to excavation and utility locates. Bidders may contact **Brent Burrier,** The City of Canton, at **brent.burrier@cantonohio.gov** or **330-438-6569** if they have any interest in accessing the Project site, independent of any pre-bid meeting.

F. ESTIMATE OF COST

1. The total estimated construction cost for the Base Bid Work for the Project for which bids are being solicited at this time is **$30,243,000.00.**

   The estimated cost for Alternate 1 - **Additional time for Owner to execute Owner-Contractor Agreement** is: **$180,000.00**.

   The estimated cost for Alternate 2 - **Canton NW Water Treatment Plant ATI filtersmart controller system** is: **$30,000.00**.

   The estimated cost for Alternate 3 - **Canton NE Water Treatment Plant ATI filtersmart controller system** is: **$50,000.00**.

   The estimated cost for Alternate 4 - **18" through 42" PCCP C301 SP-5 finished water distribution main repair kits** is: **$220,000.00**.

   The estimated cost for Alternate 5 - **Painting of Filter Pipe Gallery (Room, 108, 108A & 108B), Connected Hallways and Stairwell E & F** is: **$30,000.00**.

   The estimated cost for Alternate 6 – **Roof Replacements** is: **$450,000.00**.

G. CONTRACT DOCUMENTS

The Contract Documents consist of the documents listed in Section 1 of the Owner-Contractor Agreement.

Bidders may view and download copies of the Contract Documents from The City of Canton Purchasing web site at https://cantonohio.gov/448/Purchasing-Procurement, which is the only authorized source of the Contract Documents. The City of Canton's sourcing tool, Vendor Registry, will maintain the Bidder's list and will provide notice and copies of Addenda as issued. It is the responsibility of any person or organization interested in a hard copy of the Contract Documents to pay all costs associated with printing.

Bidders shall use complete sets of Contract Documents in preparing bids. Neither the Owner nor the Design Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.

The Owner, in making the Contract Documents available on the above terms, does so only for the purpose of obtaining bids on the Work and does not confer a license or grant for any other use.

H. PREPARATION OF BIDS

1. All bids must be submitted on the "Bid Form" furnished with the Contract Documents.

2. All blank spaces shall be filled in, in ink or typewritten, in words and figures, and in figures only where no space is provided for words, and signed by the Bidder. The wording on the Bid Form shall be used without change, alteration, or addition. Any change in the wording or omission of specified accompanying documents may cause the bid to be rejected. If there is an inconsistency or conflict in the Bid, the lowest amount shall control, whether expressed in numbers or words.

3. Bidders shall note receipt of Addenda on the Bid Form. If the Bidder fails to acknowledge receipt of each Addendum, the Bid shall be deemed non-responsive, unless the Bid amount clearly and unambiguously reflects receipt of the Addendum or the Addendum involves only a matter of form and does not materially affect the price, quantity or quality of the Work to be performed.

4. Each Bidder shall submit **an original** of its bid to the Owner. The Bid Form shall be signed with the name typed or printed below the signature. A Bid shall not be submitted by facsimile transmission or any other electronic means. A Bidder that is a corporation shall sign its bid with the legal name of the corporation followed by the name of the state of incorporation and the legal signature of an officer authorized to bind the corporation to a contract.

5. Each Bid shall be enclosed in a sealed opaque envelope with the Bidder's name and the title of the Project printed in the upper left hand corner and addressed as follows:

   The City of Canton
   ATTN: Purchasing/Bids
   218 Cleveland Avenue SW
   Canton, OH 44702

   Bids must be received at the designated location for the bid opening before 2:00:00 PM, local time, on 6/1/2022.

6. The completed Bid Form shall be accompanied by the following completed documents:

a. Pre-Bid Substitution, if any proposed substitutes have been pre-approved. (See Section K, below.)

b. Bid Guaranty and, if applicable Contract Bond (See Paragraph H.8, below.)

c. Contractor's Qualification Statement (See Paragraph I.4, below.)

d. Contractor's List of Subcontracted Work Categories (See Paragraph I.5, below.)

e. A list identifying its DBE subcontractors and participation rates as a percentage of the Contract Price, and if the DBE participation goal has not been met, certification of good faith efforts to meet the DBE participation goal. (See Section W, below.)

f. The Project Labor Agreement (PLA) Letter of Assent (See Appendix A).

g. If this project is funded in whole or part by the Ohio Public Works Commission, then certification of agreement and compliance with certain statements and covenants regarding Bidder's subscription to the State's Equal Employment Opportunity Requirements for State-assisted Construction Contracts (See Section Y, below.)

7. The Bidder shall take the following precautions in preparing its bid:

a. Sign the bid and check to ensure all blank spaces have been filled in with requested information and that the specified accompanying documents (listed in Paragraph H.6 above) have been included in a sealed opaque envelope addressed as described in Paragraph H.5 above.

b. When the Bid Form provides for quoting either an addition or deduction for an Alternate item, indicate whether the sum named is an addition or deduction. If it is not indicated, it will be conclusively presumed that the amount is a deduction.

c. When the Bid Form provides for quoting a unit price, the Bidder should quote the unit price as set forth in the Contract Documents as described in Paragraph M.1 below.

d. When applicable, make sure that the Bid Guaranty is properly executed and signed by:

1) The Bidder
2) The Surety or Sureties

e. Make sure that the amount of the Bid Guaranty (if the Bid Guaranty is in the form of a certified check, letter of credit, or cashier's check) is for a specific sum in an amount as instructed in Paragraph H.8.a below. If the Bid Guaranty is in the form of the Bid Guaranty and Contract Bond, the amount may be left blank; if an amount is inserted, it must equal the total of the base bid and all add alternates included. If inserted, then the failure to state an amount equal to the total of the base bid and all add alternates shall make the bid non-responsive if the Owner selects alternates not included in the amount.

f. Make sure that the appropriate bid package and scope of work is inserted in the correct space on the Bid Guaranty and Contract Bond Form. Failure to include work covered by the bid submitted may make the bid non-responsive.

8. Bonds and Guarantees

a. Bid Guaranty: Bidder shall furnish a Bid Guaranty, as prescribed in Sections 153.54, 153.57, and 153.571 of the Ohio Revised Code, in the form of either: (1) a bond for the full amount of the bid in the form of the Bid Guaranty and Contract Bond included in the Contract Documents; or (2) a certified check, cashier's check, or irrevocable letter of credit in a form satisfactory to the Owner in an amount equal to 10% of the bid. Bid amount shall be the total of all sums bid, including all add alternatives, but excluding all deduct alternatives. **NOTE: AIA or EJCDC Bid Bond forms are not acceptable.**

b. Contract Bond: The successful Bidder, who, as a Bid Guaranty, submits a certified check, cashier's check, or irrevocable letter of credit in an amount equal to 10% of the bid, shall furnish a Contract Bond in the form included in the Contract Documents in an amount equal to 100% of the Contract Sum. **NOTE: AIA or EJCDC Bond forms are not acceptable.**

c. The bond must be issued by a surety company authorized by the Ohio Department of Insurance to transact business in the State of Ohio and acceptable to the Owner. The bond must be issued by a surety capable of demonstrating a record of competent underwriting, efficient management, adequate reserves, and sound investments. These criteria will be deemed to be met if the surety currently has an A.M. Best Company Policyholders Rating of "A-" or better and has or exceeds the Best Financial Size Category of Class VI. Other sureties may be acceptable to the Owner, in its sole discretion.

d. All bonds shall be signed by an authorized agent of an acceptable surety and by the Bidder.

e. Surety bonds shall be supported by credentials showing the Power of Attorney of the agent, a certificate showing the legal right of the Surety Company to do business in the State of Ohio, and a financial statement of the Surety.

f. The Bid Guaranty, as applicable, shall be in the name of or payable to the order of the Owner.

g. The name and address of the Surety and the name and address of the Surety's Agent must be typed or printed on each bond.

9. Permits

a. Owner has obtained, or will obtain the following permits for the Project, as applicable:

East Central OH Building Authority Building Permit, Ohio EPA Plan Approval, OEPA NPDES Construction Site Stormwater General Permit (NOI)

b. Contractor shall secure and pay for all other permits necessary to complete the Project. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

I. METHOD OF AWARD

1. All bids shall remain open for acceptance for sixty (60) days following the day of the bid opening, but the Owner may, in its sole discretion, release any bid and return the Bid Guaranty prior to that date. The Bid Guaranty shall be subject to forfeiture, as provided in the Ohio Revised Code, if a bid is withdrawn during the period when bids are being held.

2. The Owner reserves the right to reject any, part of any, or all bids and to waive any informalities and irregularities. The Bidder expressly acknowledges this right of the Owner to reject any or all bids or to reject any incomplete or irregular bid. Bidders must furnish all information requested on the Bid Form. Failure to do so may result in disqualification of the bid.

3. Determination of the Lowest and Best Bid. Subject to the right of the Owner to reject any or all bids, pursuant to the Codified Ordinances of Canton Chapters 105, 182, and 507, the Owner will award the Contract for the Work to the bidder submitting the lowest and best bid, taking into consideration accepted alternates. In evaluating bids, the Owner will consider the qualifications of the Bidders, whether or not the bids comply with the prescribed requirements, and alternates and unit prices, if requested, on the Bid Form. The Owner may also consider the qualifications and experience of subcontractors and suppliers. The Owner may conduct such investigations as are deemed necessary to establish the qualifications and financial ability of the Bidder and its subcontractors and suppliers. The factors the Owner may consider in determining which bid is the lowest and best include the factors set forth below, including the Additional Criteria. Depending upon the type of work, the Owner, in its discretion, may also consider other essential factors, as the Owner may determine and as are included in the Specifications. The Owner, in its discretion, may consider and give such weight to these criteria as it deems appropriate. The Owner, in its discretion, reserves the right to request additional information and documentation relating to these criteria from Bidders after the bid opening.

   a. Work to be subcontracted. The Bidder must identify all work to be subcontracted. See paragraph I.5 below. All subcontractors are subject to the approval of the Owner based on the criteria set forth in this Section I.

   b. The Bidder's work history. The Bidder should have a record of consistent customer satisfaction and of consistent completion of projects, including projects that are comparable to or larger and more complex than the Owner's Project, on time and in accordance with the applicable Contract Documents, and based upon the Bidder’s claims history. If the Bidder's management operates or has operated another construction company, the Owner may consider the work history of that company in determining whether the Bidder submitted the lowest and best bid.

      The Owner will consider the Bidder's prior experience on other projects of similar scope and/or complexity including prior projects with the Owner and/or Design Professional, including the Bidder's demonstrated ability to complete its work on these projects in accordance with the Contract Documents and on time, and will also consider its ability and capacity to perform a substantial portion of the project with its own forces and its ability to work with the Owner and Engineer as a willing, cooperative, and successful team member. Bringing overstated claims,

an excessive number of claims, acting uncooperatively, and filing lawsuits against project owners and/or their design professionals on prior projects of similar scope and/or complexity will be deemed evidence of a Bidder's inability to work with the Owner and Engineer as a willing, cooperative, and successful team member.

The Bidder authorizes the Owner and its representatives to contact the owners and design professionals (and construction managers, if applicable) on projects on which the Bidder has worked and authorizes and requests such owners and design professionals (and construction managers) to provide the Owner with a candid evaluation of the Bidder's performance. By submitting its bid, the Bidder agrees that if it or any person, directly or indirectly, on its behalf or for its benefit brings an action against any of such owners or design professionals (or construction managers) or the employees of any of them as a result of or related to such candid evaluation, the Bidder will indemnify and hold harmless such owners, design professionals (and construction managers) and the employees of any of them from any claims, whether or not proven, that are part of or are related to such action and from all legal fees and expenses incurred by any of them arising out of or related to such legal action. This obligation is expressly intended for the benefit of such owners, design professionals (and construction managers), and the employees of each of them.

c. The Bidder's prior history regarding timeliness of performance, quality of work, the Bidder's history of filing claims and having claims filed against it, extension requests, fines and penalties imposed and payments thereof, and contract defaults, with explanations.

d. The Bidder's compliance with federal, state, and local laws, rules, and regulations, including but not limited to the Occupational Safety and Health Act, Ohio Prevailing Wage laws, Davis Bacon, and Ohio ethics laws.

e. The Bidder's prior experience with similar work on comparable or more complex projects.

f. The number of years the Bidder has been actively engaged as a contractor in the construction industry.

g. The Bidder's recent experience record in the construction industry, including the original contract price for each construction job undertaken by the bidder, the amount of any change orders or cost overruns on each job, the reasons for the change orders or cost overruns, and the bidder's record for complying with and meeting completion deadlines on construction projects.

h. A public entities' determination, within the previous five years, that the Bidder was not a responsible bidder, the reasons given by the public entity, and the Bidder's explanation thereof.

i. The Bidder's financial ability to complete the Contract successfully and on time without resort to its Surety.

j. Financial responsibility demonstrated by the Bidder and whether Bidder possesses adequate resources and availability of credit, the means and ability to procure insurance and acceptable performance bonds required for the Project and whether any claims have been made against performance bonds secured by the bidder on other construction projects.

k. Any suspension or revocations of any professional license of any director, officer, owner, or managerial employees of the Bidder, to the extent that any work to be performed on this Project is within the field of such licensed profession.

l. The Bidder's equipment and facilities.

m. The size and experience of the Bidder's work force and the Bidder's ability to complete the Contract successfully and on time.

n. The experience and the continuity of the Bidder's work force including the project manager and project superintendent's tenure with the Bidder.

o. The Bidder's participation in a drug-free workplace program acceptable to the Owner, and the Bidder's record for both resolved and unresolved findings of the Auditor of State for recovery as defined in Section 9.24 of the Ohio Revised Code.

p. The Owner's prior experience with the Bidder's surety.

q. The Bidder's interest in the Project as evidenced by its attendance at any pre-bid meetings or conferences for bidders.

r. The adequacy, in numbers and experience, of the Bidders' work force to complete the Contract successfully and on time.

s. The foregoing information with respect to each of the Subcontractors and Suppliers that the Bidder intends to use on the Project.

4. Qualifications Statement. Each Bidder will submit with its bid a completed Contractor Qualifications Statement, which is included with the Contract Documents, and thereafter provide the Owner promptly with such additional information as the Owner may request regarding the Bidder's qualifications. A Bidder shall submit any requested additional information within three (3) business days of the date on the request.

5. List of Subcontracted Work Categories. Each Bidder will submit with its bid a completed list of Subcontracted Work Categories, which is included with the Contract Documents, and thereafter provide the Owner promptly with such additional information as the Owner may request regarding the Bidder's qualifications. A Bidder shall submit any requested information within three (3) business days of the date on the request.

6. Additional Criteria for Determining Lowest and Best Bid. Pursuant to the Codified Ordinances of the City of Canton, Chapter 105, the Owner, in its discretion, may consider any or all of the Additional Criteria below in determining which bid is lowest and best.

a. Any OSHA violations within the previous three years, as well as all notices of OSHA citations filed against the Bidder in the same three year period, together with a description and explanation of remediation or other steps taken regarding such violations and notices of violation.

b. Any violations within the previous five years pertaining to unlawful intimidation or discrimination against any employee by reason of race, creed, color, disability, gender, or national origin, and/or violation of any employee's civil or labor rights or equal employment opportunities.

c. Any litigation in which the Bidder has been named as a defendant or third party defendant in an action involving a claim for personal injury or wrongful death

arising from performance of work related to any project in which it has been engaged within the previous five years. Bidders shall provide copies of pleadings.

d. Allegations of violations of the prevailing wage law and any other state or federal labor law, including, but not limited to, child labor violations, failure to pay wages, or unemployment insurance tax delinquencies or unfair labor practices within the past five years.

e. Violations of the workers compensation law.

f. Any criminal convictions or criminal indictments, involving the Bidder, its officers, directors, owners, and/or managers within the past five years.

g. Any violation within the past five years or pending charges concerning federal, state, or municipal environmental and/or health laws, codes, rules, and/or regulations.

h. Documentation that the Bidder provides health insurance and pension benefits to its employees.

i. Whether the Bidder participates in a bona fide apprenticeship program that is approved by the Ohio State Apprenticeship Council and the United States Department of Labor.

j. Whether the Bidder has adopted and implemented a comprehensive drug and alcohol testing program for its employees.

k. Whether the Bidder's employees are OSHA-10 and/or OSHA-30 certified.

l. The Bidder's commitment to comply with the Owner's Contract Compliance Program regarding equal employment opportunity. Each Bidder shall file contract employment reports with the Owner's contracting agency or as may be directed by the Owner or its representative. Such contract employment reports shall include such information as to the employment practices, policies, programs, and statistics of the Bidder and shall be in such form as the Owner may prescribe.

m. The foregoing information with respect to each of the Subcontractors and Suppliers that the Bidder intends to use on the Project.

7. The failure to submit information that Owner has the right to receive under these Instructions to Bidders on a timely basis may result in the determination that the Bidder has not submitted the lowest and best bid.

8. By submitting its bid, the Bidder agrees that the Owner's determination of which bidder is the lowest and best bidder shall be final and conclusive, and that if the Bidder or any person on its behalf challenges such determination in any legal proceeding, the Bidder will indemnify and hold the Owner and its employees and agents harmless from any claims included or related to such legal proceeding, and from legal fees and expenses incurred by the Owner, its employees, or agents that arise out of or are related to such challenge.

9. After bid opening, within three (3) business days of a request made by the Owner, the apparent low Bidder and any other Bidder so requested by the Owner must submit the following:

For all subcontracts with an estimated value of at least $50,000, a list of all Subcontractors that the Bidder will use to construct the Project, as well as an indication of

whether or not the Bidder has ever worked with a proposed Subcontractor before, including the following information for the three most recent projects on which the Bidder and each Subcontractor have worked together:

i. Project Owner

ii. Project Name

iii. Subcontract Scope

iv. Subcontract Value

v. Owner's contact name and phone number.

If Bidder and a proposed Subcontractor have not worked together on at least three projects in the past five years, Bidder must submit the information set forth above for the three most recent similar projects to the Project that a proposed Subcontractor has worked on.

The above Subcontractor information, as well as the criteria set forth in Paragraph I.3 herein, as it pertains to each Subcontractor may be used in the Owner's determination of the lowest and best bid.

Once a Bidder identifies its proposed Subcontractors as set forth in this Paragraph I.9, the list shall not be changed unless written approval or direction for the change is made by Owner.

10. Additional Post-Bid Submittals

a) Affidavit as to Personal Property Taxes. The successful Bidder shall submit, prior to the time of the entry into the Contract, an affidavit in the form required by Section 5719.042, Ohio Revised Code, regarding the status of the Bidder's personal property taxes. A copy of the affidavit form is included with the Contract Documents.

11. The Owner reserves the right to disqualify bids, before or after opening, upon evidence of collusion with intent to defraud or other illegal practices on the part of the Bidder.

12. Award of Contract. The award of the Contract will only be made pursuant to approval of the City's Board of Control.

J. EXECUTION OF CONTRACT

1. Within the time designated by the Owner after award of the Contract, the successful Bidder shall execute and deliver to the Owner the required number of copies of the Owner-Contractor Agreement, in the form included in the Contract Documents, and all accompanying documents requested, including, but not limited to, a Contract Bond (if applicable), insurance certificates, and a valid Workers' Compensation Certificate. The successful Bidder shall have no property interest or rights under the Owner-Contractor Agreement until the Agreement is executed by the Owner.

K. SUBSTITUTIONS/NON-SPECIFIED PRODUCTS

1. Certain brands of material or apparatus may be specified. Should this be the case, each bid will be based on these brands, which may be referred to in the Contract Documents as Standards. The use of another brand (referred to as a substitution or proposed equal in the Contract Documents, when a bidder or the contractor seeks to have a different brand of material or apparatus than that specified approved by the Owner of use in the

Project) may be requested as provided herein. Substitutions, however, will not be considered in determining the lowest and best bid.

2. The products specified in the Contract Documents establish a standard of required function, dimension, appearance, and quality.

3. Bidders wishing to obtain approval to bid non-specified products shall submit written requests to the Owner a minimum of seven (7) working days before the bid date and hour. To facilitate the submission of requests, a Substitution Form is included in the Contract Documents. The Bidder shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution, including the name of the proposed manufacturer and/or product and a complete description of the product including the manufacturer's name and model number or system proposed, drawings, product literature, performance and test data, color selections or limitations, and any other information necessary for evaluation. Include a statement including any changes in other materials, equipment, or other work that would be required if the proposed product is incorporated in the work. The burden of proof of the merit of the proposed product is on the proposer. The Owner's decision on approval of a proposed product will be final.

   The following will be cause for rejection of a proposed substitution:

   a. Requests submitted by subcontractors, material suppliers, and individuals other than Bidders;

   b. Requests submitted without adequate documentation;

   c. Requests received after the specified cut-off date;

   d. Requests, which in the sole discretion of the Owner, do not offer a sufficient benefit to the Project.

4. When the Owner approves a product submission before receipt of bids, the approval will be included in an Addendum, and Bidders may include the pricing of this product in their bid. Bidders shall not rely on approvals made in any other manner.

5. In proposing a non-specified product or a substitution, the Bidder represents and warrants that each proposed product will not result in any changes to the Project, including changes to the Work or other contractors, or any decrease in the performance of any equipment or systems to be installed in the Project and agrees to pay any additional costs incurred by the Owner and the Owner's consultants as a result of a non-specified or substitute product that is accepted.

6. If an addendum is issued approving a substitution for a specified Standard, any Bidder proposed to use said substitution must indicate so with its Bid, using the form provided.

7. Following the award of the Contract, there shall be no substitution for specified products, except pursuant to a Change Order. The Owner in its sole discretion may decline to consider a substitution for a Change Order.

8. The Owner reserves the right to value engineer any item within the specifications if it is deemed to be in the best interest of the Owner.

L. ALTERNATES

1. The Owner may request bids on alternates. At the time of awarding the Contract, the Owner will select or reject alternates as it determines is in its best interest. A Bidder's

failure to include on its Bid Form the cost of an alternate selected by the Owner and applicable to the Bidder's work shall render the bid non-responsive and be grounds for the rejection of the bid. Otherwise, the failure to include the cost of an alternate will not be deemed material.

2. The Bidder acknowledges that although there is an estimate for the cost of the Project, the market conditions may and frequently do result in the estimate being different from the sum of the bids received, either higher or lower. The Bidder understands that the Owner may include alternates, which may include deduct alternates as well as add alternates, to give it flexibility to build the Project with the funds available. The Bidder further understands and acknowledges that use of add and deduct alternates is a long held customary practice in the construction industry in the State of Ohio. The Bidder also acknowledges that the Owner will not make a decision about the alternates on which to base the award of contracts until the bids are received, and the Owner can compare its available funds with the base bids and the cost or savings from selecting different alternates. The Bidder understands that the award to the Bidder submitting the lowest and best bid will be based on the base bid plus selected alternates, and may result in an award to a Bidder other than the Bidder that submitted the lowest base bid.

M. UNIT PRICES

1. Where unit prices are requested in the Bid Form the Bidder should quote a unit price. Unless otherwise expressly provided in the Contract Documents, such unit prices shall include all labor, materials, and services necessary for the timely and proper installation of the item for which the unit prices are requested. The unit prices quoted in the bid shall be the basis for any Change Orders entered into under the Owner-Contractor Agreement, unless the Owner determines that the use of such unit prices will cause substantial inequity to either the Contractor or the Owner.

N. ADDENDA

1. All questions should be submitted in writing at least five (5) business days prior to the bid opening. **This is 5/25/2022, 2:00:00 PM.** The Owner reserves the right to issue Addenda changing, altering, or supplementing the Contract Documents prior to the time set for receiving bids. The Owner will issue the Addenda to clarify bidders' questions and/or to change, alter, or supplement the Contract Documents.

2. Any explanation, interpretation, correction, or modification of the Contract Documents will be issued in writing in the form of an Addendum, which shall be the only means considered binding; explanations, interpretations, etc., made by any other means shall NOT be legally binding. All Addenda shall become a part of the Contract Documents.

3. All Addenda will be issued, except as hereafter provided, via the current City bid tool at least seventy-two (72) hours prior to the published time for the opening of bids, excluding Saturdays, Sundays, and legal holidays. If any Addendum is issued within such seventy-two (72) hour period, then the time for opening of bids shall be extended one (1) week with no further advertising of bids required.

4. Copies of each Addendum will be posted via the Owner's current bid tool and it is the responsibility of the bidder or any other interested party to check the bid tool for any updates or addenda. Receipt of Addenda shall be indicated by Bidders in the space provided on the Bid Form. Bidders are responsible for acquiring issued Addenda in time to incorporate them into their bid. Bidders should check the Owner's bid tool prior to the bid opening to verify the number of Addenda issued.

5. Each Bidder shall carefully read and review the Contract Documents and immediately bring to the attention of the Owner any error, omission, inconsistency, or ambiguity therein.

6. If a Bidder fails to indicate receipt of all Addenda through the last Addendum issued by the Owner on its Bid Form, the bid of such Bidder will be deemed to be responsive only if:

   a. The bid received clearly indicates that the Bidder received the Addendum, such as where the Addendum added another item to be bid upon and the Bidder submitted a bid on that item; or

   b. The Addendum involves only a matter of form or is one which has either no effect or has merely a trivial or negligible effect on price, quantity, quality, or delivery of the item bid upon.

O. INTERPRETATION

1. If a Bidder contemplating submitting a bid for the proposed Project is in doubt as to the true meaning of any part of the Contract Documents, it may submit a written request for an interpretation thereof to the Owner at purchasing@cantonohio.gov. Requests received fewer than 5 days prior to bid opening may not be answered. Any interpretation of the proposed documents will be made by Addendum only and will be made available by the City's web tool. The Owner will not be responsible for any other explanation or interpretation of the proposed documents.

2. In interpreting the Contract Documents, words describing materials that have a well-known technical or trade meaning, unless otherwise specifically defined in the Contract Documents, shall be construed in accordance with the well-known meaning recognized by the trade.

3. Bidders are responsible for notifying the Owner in a timely manner of any ambiguities, inconsistencies, errors, or omissions in the Contract Documents. The Bidder shall not, at any time after the execution of the Contract, be compensated for a claim alleging insufficient data, incomplete Contract Documents, or incorrectly assumed conditions regarding the nature or character of the Work, if no request was made by the Bidder prior to the bid opening.

P. STATE SALES AND USE TAXES

1. The Owner is a political subdivision of the State of Ohio and is exempt from taxation under the Ohio Sales Tax and Use Tax Laws. Building materials that the successful Bidder purchases for incorporation into the Project will be exempt from state sales and use taxes if the successful Bidder provides a properly completed Ohio Department of Taxation Construction Contract Exemption Certificate to the vendors or suppliers when the materials are acquired. The Owner will execute properly completed certificates on request.

Q. DATE FOR SUBSTANTIAL COMPLETION/DATE FOR FINAL COMPLETION/LIQUIDATED DAMAGES

1. Dates for Substantial Completion. The Contract Time shall run from the date of the Notice to Proceed or if there is no Notice to Proceed from the Effective Date of the Owner-Contractor Agreement. The Date for Substantial Completion and the Contract Time may be extended only by Change Order. **By submitting its Bid, each Bidder agrees that the period for performing its Work is reasonable.**

a. Date for Overall Project Substantial Completion. The successful Bidder shall have all of its Work on the Project Substantially Complete (as Substantial Completion is defined in the Contract Documents) by the following date as applicable to the Bidder's scope of work.

Date for Substantial Completion (aka Contract Time) expressed as calendar days from Notice to Proceed:

913 calendar days

2. Liquidated Damages.

a. Overall Project Substantial Completion. If the successful Bidder does not have its Work Substantially Complete by its Date for Substantial Completion or Finally Complete within thirty (30) calendar days of achieving Substantial Completion, whichever may be applicable, the successful Bidder shall pay the Owner and the Owner may set off from amounts otherwise due the successful Bidder Liquidated Damages. The daily amounts of Liquidated Damages for Overall Project Substantial Completion are set forth in the tables included in the Owner-Contractor Agreement. The total amount of Liquidated Damages will be calculated based on the total number of calendar days beyond the Date for Substantial Completion that the Bidder's Work is not Substantially Complete or to the extent that its Work is not Finally Complete more than thirty (30) calendar days after the Substantial Completion of its Work, i.e., number of late days times the per diem rate(s) for Liquidated Damages in the tables.

3. The Bidder acknowledges and agrees, by submitting its bid for the Work and entering into a Contract with the Owner, that such amounts of Liquidated Damages represent a reasonable estimate of the actual damages for loss of or interference with the intended use of the Project that the Owner would incur if the Bidder's Work is not Substantially Complete by its Date for Substantial Completion and/or not Finally Complete by thirty (30) days of the Date of Substantial Completion. The Bidder further acknowledges, agrees and understands that it may seek an extension of the Contract Time (and its Date for Substantial Completion) to avoid or reduce Liquidated Damages by properly following the Claim procedures in the Contract Documents.

R. OWNER'S RIGHT TO WAIVE DEFECTS AND IRREGULARITIES

1. The Owner reserves the right to waive any and all irregularities provided that the defects and irregularities do not affect the amount of the bid in any material respect or otherwise give the Bidder a competitive advantage.

S. MODIFICATION/WITHDRAWAL OF BIDS

1. Modification. A Bidder may modify its bid by written communication to the Owner at any time prior to the scheduled closing time for receipt of bids, provided such written communication is received by Owner prior to the bid deadline. The written communication shall not reveal the bid price, but should provide the addition or subtraction or other modification so that the final prices or terms will not be known until the sealed bid is opened. If the Bidder's written instructions with the change in bid reveal the bid amount in any way prior to the bid opening, the bid may be rejected as non-responsive.

2. Withdrawal Prior to Bid Deadline. A Bidder may withdraw its bid at any time for any reason prior to the bid deadline for the opening of bids established in the Legal Notice. The request to withdraw shall be made in writing to and received by the Owner prior to the time of the bid opening.

3. Withdrawal after Bid Deadline.

   a. All bids shall remain valid and open for acceptance for a period of at least 60 days after the bid opening; provided, however, that a Bidder may withdraw its bid from consideration after the bid deadline when all of the following apply:

      (1) the price bid was substantially lower than the other bids;

      (2) the reason for the bid being substantially lower was a clerical mistake, rather than a mistake in judgment, and was due to an unintentional and substantial error in arithmetic or an unintentional omission of a substantial quantity of work, labor, or material;

      (3) the bid was submitted in good faith; and

      (4) the Bidder provides written notice to the Owner within two (2) business days after the bid opening for which the right to withdraw is claimed.

   b. No bid may be withdrawn under this provision if the result would be the awarding of the contract on another bid for the bid package from which the Bidder is withdrawing its bid to the same Bidder.

   c. If a bid is withdrawn under this provision, the Owner may award the Contract to another Bidder determined by the Owner to be the lowest and best bidder or the Owner may reject all bids and advertise for other bids. In the event the Owner advertises for other bids, the withdrawing Bidder shall pay the costs incurred in connection with the rebidding by the Owner, including the cost of printing new Contract Documents, required advertising, and printing and mailing notices to prospective bidders, if the Owner finds that such costs would not have been incurred but for such withdrawal.

T. COMPLIANCE WITH APPLICABLE LAWS - Please find Equal Employment Opportunity Certification requirements and form within Appendix C – Construction Contract Guidance document (form must be submitted with bid).

1. By submitting a bid for Work on the Project, the Bidder acknowledges that it is in compliance with applicable federal, state, and local laws and regulations, including, but not limited to, the following:

   a. Equal Employment Opportunity/Nondiscrimination. The Bidder agrees that if it is awarded a contract that in the hiring of employees for performance of work under the contract or any subcontract, neither it nor any subcontractor, or any person acting on its behalf or its subcontractor's behalf, by reason of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color, shall discriminate against any citizen of the state in the employment of labor or workers who are qualified and available to perform work to which the employment relates. The Bidder further agrees that neither it nor any subcontractor or any person on its behalf or on behalf of any subcontractor, in any manner, shall discriminate against or intimidate any employees hired for the performance of the work under the contract on account of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color.

   b. Ethics Laws. The Bidder represents that it is familiar with all applicable ethics law requirements, including without limitation Sections 102.04 and 3517.13 of the Ohio Revised Code, and certifies that it is in compliance with such requirements.

U. FINDINGS FOR RECOVERY - Please find Debarment requirements within Appendix C – Construction Contract Guidance document (form must be submitted with bid).

1. By submitting its bid, each Bidder certifies for reliance of the Owner that it has no unresolved finding for recovery against it issued by the Auditor of the State of Ohio on or after January 1, 2001, except as permitted by Section 9.24 (F) of the Ohio Revised Code.

V. PREVAILING WAGES - Davis Bacon Wages and Requirements apply to this bid/project/contract. Please find requirements within Appendix C – Construction Contract Guidance document.

1. ~~The Project is a "Construction" project as defined in Section 4115.03 of the Ohio Revised Code. If the Project is defined as such as "Construction" project, the successful Bidder and all of its subcontractors, regardless of tier, will strictly comply with its obligation to pay a rate of wages on the Project not less than the rate of wages fixed for this Project under Section 4115.04 of the Ohio Revised Code. Additionally, the successful Bidder will comply with all other provisions of Chapter 4115 of the Ohio Revised Code.~~

W. DBE PARTICIPATION GOALS - Disadvantaged Business Enterprises (DBE) Utilization Requirements apply to this bid/project/contract. Please find requirements within Appendix C – Construction Contract Guidance document.

1. Owner has established the following Disadvantaged Business Enterprise ("DBE") participation goal for the Project as a percentage of the Contract Price:

10%

2. Any Minority Business Enterprise ("MBE") or Woman-Owned Business Enterprise ("WBE") proposed to count towards the DBE participation goal must first be certified at bid time as an MBE or WBE under the Ohio Department of Administrative Services MBE Cross Certification Program (which includes MBEs and WBEs certified by the City of Canton), or certified as a DBE under Ohio's Unified Certification Program administered by the Ohio Department of Transportation.

3. **Documentation of DBE Participation. Each Bidder must submit with its bid a list identifying its DBE subcontractors and participation rates as a percentage of the Contract Price.**

4. **Certification of Good Faith Efforts. If a Bidder has not met the DBE participation goal, it must attach to its bid, a narrative (which may include exhibits) demonstrating the good faith efforts made by the Bidder to secure DBE participation in the Project. Good faith efforts include:**

   - **Conducting outreach and recruiting activities;**
   - **Informing DBEs of the opportunity to participate in the Project at least 30 calendar days before the bid closes;**
   - **Considering subcontracting with a consortium of DBEs; and**
   - **Using the services and assistance of the Small Business Administration and Minority Development Agency of the U.S. Department of Commerce.**

   Owner, in its sole discretion, will be the sole evaluator of whether any particular Bidders' efforts sufficiently demonstrate good faith efforts for securing DBE participation.

5. Challenges to Owner's Discretion. If any Bidder directly challenges, or indirectly challenges through contribution of money or other resources to a third party, Owner's discretion in determining any Bidder's compliance with the DBE goal stated in these Instructions to Bidders, or good faith efforts pertaining to same, that Bidder agrees to indemnify Owner for all claims, costs, losses and damages, including attorney and consultant fees, arising out of such challenge, should there be an adjudication by a court of competent jurisdiction that the Owner did not abuse its discretion in making its determination.

6. Failure to Comply. If a Bidder is awarded a contract for the Project, and later fails to fulfill its stated DBE participation goals, that Bidder agrees to indemnify Owner for all claims, costs, losses and damages, including attorney and consultant fees, arising out of such failure. That Bidder also agrees to cooperate with all reasonable requests to determine actual DBE participation, including but not limited to certifying actual participation and providing documentation in support of same.

X. OTHER LOCAL ORDINANCE REQUIREMENTS

1. Each Bidder, by the act of submitting its bid agrees to withhold all City income taxes due or payable under Chapter 182 of the Codified Ordinances of the City of Canton for wages, salaries, fees, and commissions paid to its employees and further agrees that any of its subcontractors shall be required to agree to withhold any such City income taxes due for services performed under this Agreement. Bidder agrees with the Owner regarding the manner of withholding of City income taxes as provided in Section 718.011(F) of the Ohio Revised Code. Municipal income tax withholding provisions of Section 718.011(B)(1) and 718.011(D) of the Ohio Revised Code shall not apply to qualifying wages paid to employees for work done or services performed or rendered inside the City or on City property. Each Bidder agrees to withhold income tax for the City from employees' qualifying wages earned inside the City or on City property, beginning with the first day of work done or services performed or rendered inside the City.

2. Each Bidder, by the act of submitting its bid agrees that all steel necessary in the construction of the Work performed under the Agreement shall be steel that is produced in the United States unless a specific product which is required is not produced by manufacturers in the United States in which event this prohibition does not apply. **Please find additional information, requirements and an acknowledgement form in Appendix C Construction Contract Guidance.**

3. Each Bidder, by the act of submitting its bid agrees that all materials used in the construction covered by the Agreement shall be purchased in the Canton area except such materials which are unavailable in the Canton area.

4. Chapter 105.12 – Local Bidder Preference.

   a. The Board of Control, in determining the lowest and best bidder in the award of contracts to which this section is applicable, is authorized to award contracts to local bidders as hereinafter defined, whose bid is not more than five percent (5%) higher, subject to a maximum amount of twenty thousand dollars ($20,000.00), than the lowest dollar bid submitted by non-local bidders. The Board of Control's decision in making such an award shall be final.

   b. For purposes of this section, "local bidder" means an individual or business entity which at the time of the award of the contract has a headquarters, division, sales office, sales outlet, manufacturing facility, or similar significant business-related location in Stark County, Ohio.

c. All contract specifications and/or bid documents that are distributed by Canton for the purpose of soliciting bids for goods and/or services shall contain the following notice:

Prospective bidders will take notice that the City of Canton, in determining the lowest and best bidder in the award of this contract, may award a local bidder preference to any qualified bidder pursuant to Section 105.12 of the Codified Ordinances of the City of Canton. The determination of whether a bidder qualifies for the local preference shall be made by Board of Control. The Board's decision shall be final. A copy of Section 105.12 is attached.

d. This section shall be applicable to all contracts for equipment, goods, machinery, materials, supplies, vehicles and/or services, which are purchased, leased and/or constructed at a cost in excess of fifty thousand dollars ($50,000.00) and which require bidding pursuant to Ohio R.C. 735.05 through 735.09 and Ohio R.C. 737.03. (Ord. 115-2018. Passed 5-14-18.)

5. Each Bidder, by the act of submitting its bid agrees as follows during the performance of the Agreement:

a. The Contractor shall not discriminate against any employee or applicant for employment because of race, age, handicap, religion, color, sex, national origin, sexual orientation, or gender identity. The Contractor shall take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to race, religion, color, sex, national origin, military status, sexual orientation, or gender identity. As used herein, the word “treated” shall mean and include without limitation the following: recruited, whether by advertising or other means; compensation, whether in the form of rates or pay or other forms of compensation; selected for training, including apprenticeship; promoted; demoted; upgraded; downgraded; transferred; laid off; and terminated. The Contractor agrees to and shall post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting officers setting forth the provisions of this nondiscrimination clause.

b. The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, age, handicap, religion, color, sex, national origin, military status, sexual orientation, or gender identity.

c. The Contractor shall send to each labor union or representative of workers, with which he has a collective bargaining agreement or other contract or understanding, a notice advising the labor union or workers’ representative of the Contractor’s commitments under the equal opportunity clause of the Owner; and it shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The Contractor shall submit in writing to the Owner its affirmative action plan, and each subcontractor and supplier of equipment or supplies shall submit to the Contractor its affirmative action plan. The responsibility for securing these affirmative action plans falls upon the Contractor and shall be on file at the office of the Contractor. The Contractor shall furnish all information and reports required by the Owner or its representative pursuant to the Contract Documents, and shall permit access to its books, records, and accounts by the contracting agency of the Owner and by the Executive Secretary of the Owner for purposes of investigation to ascertain compliance with the program.

e. The Contractor shall take such action with respect to any subcontractor as the Owner may direct as a means of enforcing the provisions of this equal opportunity clause, including penalties and sanctions for noncompliance; provided, however, that in the event the Contractor becomes involved in or is threatened with litigation as is necessary to protect the interests of the Owner and to effectuate the Owner's equal opportunity program and, in the case of contracts receiving Federal assistance, the Contractor or the Owner may request the United States to enter into such litigation to protect the interests of the United States.

f. The Contractor shall file and shall cause its subcontractors, if any, to file compliance reports with the Owner in the form and to the extent prescribed by the Owner or its representative. Compliance reports filed at such times as directed shall contain information as to the employment practices, policies, programs, and statistics of the Contractor and its subcontractors.

g. The Contractor shall include the provisions of this equal employment opportunity clause in every subcontract or purchase order, so that such provisions will be binding upon each subcontractor or vendor.

h. Refusal by the Contractor or subcontractor to comply with any portion of this program as herein stated and described will subject the offending party to any or all of the following penalties:

(1) Withholding of all future payments under the involved public contract to the Contractor in violation, until it is determined that the Contractor or subcontractor is in compliance with the provisions of the Agreement.

(2) Refusal of all future bids for any public contract with the Owner or any of its departments or divisions, until such time as the Contractor or subcontractor demonstrates that it has established and shall carry out the policies of the program as herein outlined.

(3) Cancellation of the public contract and declaration of forfeiture of the performance bond.

(4) In cases is which there is substantial or material violation or the threat of substantial or material violation of the compliance procedure or as may be provided by contract, appropriate proceedings may be brought to enforce these provisions, including enjoining within applicable laws of contractors, subcontractors, or other organizations, individuals, or groups who prevent, directly or indirectly, or seek to prevent, directly or indirectly, compliance with the policy as herein outlined.

2. A Project Labor Agreement (PLA) has been required for this project (See Appendix A if applicable). Prevailing Wages are required for this Project (See Appendix B).

Y. OHIO PUBLIC WORKS COMMISSION FUNDING

1. **No** When this line is checked by the Owner, e.g. with an "X" or other mark, the Project is being funded in whole or part by the Ohio Public Works Commission ("OPWC"), and the requirements of the OPWC, attached to these Instructions to Bidders, apply.

2. The OPWC requirements include that the Bidder include with its bid certification of agreement and compliance with certain statements and covenants regarding its subscription to the State's Equal Employment Opportunity Requirements for State-assisted Construction Contracts.

END OF INSTRUCTIONS TO BIDDERS

OWNER-CONTRACTOR AGREEMENT

[Where Engineer is a Third Party Hired by Owner and Engineer Has Construction Administration Duties]

Owner:
The City of Canton
218 Cleveland Avenue SW
Canton, OH 44702
Telephone: 330.489.3283

Contract: ____
Ordinance: 11/2022
Alternates: ____

Contractor:
____
____
____, ____ 0
Telephone: ____
Fax: ____

Project: Sugar Creek Water Treatment Plant & Wellfield Improvements

This document is an agreement between the Owner and the Contractor for the Work described in the Contract Documents related to the Contract identified above for the Project defined above and is effective as of the date the Agreement is signed by the Owner (the "Effective Date").

The Owner and the Contractor agree as set forth in the following sections:

1. CONTRACT DOCUMENTS. The Contract Documents consist of the following documents:

A. Legal Notice;
B. Instructions to Bidders;
C. Bid Form;
D. Owner-Contractor Agreement;
E. General Conditions of the Contract for Construction (EJCDC C-700), as modified;
F. Supplementary Conditions (when applicable);
G. Drawings;
H. Specifications;
I. Project Labor Agreement (if applicable)
J. Addenda issued;
K. Contractor's Personal Property Tax Affidavit (O.R.C. 5719.042);
L. Statement of Claim Form; and
M. Modifications issued after the execution of the contract, including:
   i. A Change Order;
   ii. A Work Change Directive; or,
   iii. A written order for a minor change of the Work issued by the Owner or Engineer in accordance with the General Conditions.

N. **X** When this line is checked by the Owner, e.g. with an "X" or other mark, the State of Ohio Department of Transportation, Construction and Material Specifications, effective as of January 1, 2019, will be a Contract Document, but only as modified by the document titled *ODOT Manual Supplement*, prepared by Owner.
O. Project Labor Agreement (if applicable)

1.1 Notwithstanding anything in the Contract Documents to the contrary, in the event of any inconsistency, the provisions of this Agreement shall control over any other Contract Document, proposal, document, or other attachment. In the event inconsistencies, conflicts, or ambiguities between or among the Contract Documents

are discovered after execution of the Agreement, Contractor shall provide the better quality or greater quantity of Work or comply with the more stringent requirements.

Note: **Non-Contract Documents**. The following are the reports and tests of subsurface conditions at or contiguous to the Site, if any, that the Engineer has used in preparing the Contract Documents. These are not Contract Documents. Geotechnical data is not a warranty of subsurface conditions and is not to be relied upon as a complete representation of all possible soil conditions. It is possible that there may be other reports, and/or tests of subsurface conditions at or contiguous to the Site not prepared by or on behalf of Owner. The Owner makes no representation about such reports and/or tests, assuming they exist. Additional information, if needed by Contractor for geotechnical data or site survey, shall be obtained by the Contractor at no additional cost to Owner. The General Conditions, as modified, contain additional terms related to these reports and tests.

Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings listed below, and except for such reliance on "technical data," Contractor shall not rely upon or make any claim against Owner or Engineer with respect to: (1) the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or (2) other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or (3) any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information. For example, all interpolations and extrapolations of data performed by Contractor to estimate locations or quantities of subsurface strata are independent factual assumptions which Owner does not warrant. (Not applicable, if none are listed).

____

Note: **Non-Contract Documents**. The following are those reports and drawings related to any Hazardous Conditions at the Site, if any. These are not Contract Documents. The General Conditions, as modified, contain additional terms related to these reports and drawings. (None if none are listed).

____

2. ENGINEER RELATIONSHIP. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Engineer and the Contractor or any Subcontractor or Material Supplier to the Project. The Engineer, however, shall be entitled to performance of the obligations of the Contractor intended for its benefit and to enforcement of such obligations, but nothing contained herein shall be deemed to give the Contractor or any third party any claim or right of action against the Engineer that does not otherwise exist without regard to this Contract. The Contractor and its Subcontractors shall not be deemed to be beneficiaries of any of the acts or services of the Engineer that are performed for the sole benefit of the Owner. The Contractor shall forward all communications to the Owner through the Engineer and hereby acknowledges and agrees that any instructions, reviews, advice, approvals, orders, or directives that are rendered to it by the Engineer are specifically authorized and directed by the Owner to the Contractor through the Engineer acting on behalf of the Owner.

Engineer will be performing construction administration duties as identified in the General Conditions, including, but not limited to: reviewing Applications for Payment, Change Proposals, Claims, and Shop Drawings; measuring Work quantities; and issuing Work Change Directives.

2.1 The Engineer is:
Burgess & Niple, Inc.
100 West Erie Street
Painesville, Ohio 44077

3. TIME FOR COMPLETION AND PROJECT COORDINATION.

3.1 DATE OF COMMENCEMENT. The date of commencement of the Work shall be the date identified in the Notice to Proceed issued by the Owner, or by the Owner through the Engineer, to the Contractor, or if there is no Notice to Proceed, the Effective Date of this Agreement.

3.2 DATE OF SUBSTANTIAL COMPLETION. The Project and Work for the Project consists of all labor, materials, equipment, and services necessary for construction of the Project, all in accordance with the Drawings and Specifications prepared by the Owner or Engineer. The Contractor shall achieve Substantial Completion of its Work on the Project, as defined in the General Conditions, within **913 calendar days** of the Date of Commencement ("Date of Substantial Completion"). Substantial Completion is the time at which the Work has progressed to the point where the Work is sufficiently complete, in accordance with the Contract Documents, so that the Work can be utilized for the purposes for which it is intended.

3.2.1 DATE OF FINAL COMPLETION. The Contractor shall achieve Final Completion of its Work on the Project, as defined in the General Conditions, within **30 calendar days** of the Date of Substantial Completion ("Date of Final Completion"). Final Completion shall mean that the Work is complete in accordance with the Contract Documents and the Contractor has submitted to the Owner or Engineer all documents required to be submitted to the Owner or Engineer for final payment.

3.2.2 UTILITIES AND OPERATIONS. Contractor shall not interrupt utilities to facilities or existing operations without prior written notice and approval by Owner.

3.2.3 SHUTDOWN DATES. Due to events scheduled by the Owner and/or other Owner considerations, Contractor will not be able to perform Work on the Project on the following dates (there are no shutdown dates if none are listed): ____

Contractor's Construction Schedule for performing the Work shall account for Contractor not being able to perform Work on these dates and the contractual dates for Substantial Completion and Final Completion will not be changed due to Contractor not being able to perform Work on these dates.

3.3 CONSTRUCTION SCHEDULE. The Construction Schedule shall be developed by the Contractor as provided in the Contract Documents.

3.4 LIQUIDATED DAMAGES. If the Contractor does not have its Work on the Project Substantially Complete by the specified Date for Substantial Completion or Finally Complete by the Date of Final Completion, the Contractor shall pay the Owner (and the Owner may set off from sums coming due the Contractor) Liquidated Damages in the per diem amounts as set forth in the following tables, whichever may be applicable. "Contract Amount" of the Work will be determined by totaling the cost of all line items of Work.

LIQUIDATED DAMAGES – DATE FOR SUBSTANTIAL COMPLETION OF OVERALL PROJECT

Original Contract Amount	Dollars Per Day
$1.00 to $500,000.00	$ 750.00
$500,000.01 to $2,000,000.00	$ 1,000.00
$2,000,000.01 to $10,000,000.00	$ 1,300.00
$10,000,000.01 to $50,000,000.00	$ 2,000.00
$50,000,000.01 and greater	$ 2,500.00

LIQUIDATED DAMAGES – FINAL COMPLETION

Original Contract Amount	Dollars Per Day
$1.00 to $500,000.00	$ 200.00
$500,000.01 to $2,000,000.00	$ 250.00
$2,000,000.01 to $10,000,000.00	$ 325.00
$10,000,000.01 to $50,000,000.00	$ 500.00
$50,000,000.01 and greater	$ 625.00

LIQUIDATED DAMAGES FOR SUBSTANTIAL COMPLETION FOR ANY INTERIM MILESTONE SCOPE WILL BE $1,000 PER DAY FOR EACH DAY OF UNEXCUSED DELAY BEYOND THE MILESTONE.

The Contractor acknowledges that such amounts of Liquidated Damages represent a reasonable estimate of the actual damages for loss of or interference with the intended use of the Project that the Owner would incur if the Contractor's Work is not Substantially Complete by its Date for Substantial Completion or Finally Complete by the required date for Final Completion.

4. CONTRACT SUM (also called Contract Price). The Contract Sum to be paid by the Owner to the Contractor, as provided herein, for the satisfactory performance and completion of the Work and all of the duties, obligations, and responsibilities of the Contractor under this Agreement and the other Contract Documents is , subject to adjustment as set forth in the Contract Documents. The Contract Sum includes Allowances, Accepted Alternates, and all federal, state, county, municipal, and other taxes imposed by law, including but not limited to any sales, use, commercial activity, and personal property taxes payable by or levied against the Contractor on account of the Work or the materials incorporated into the Work. The Contractor will pay any such taxes. The Contract Sum includes the following:

4.1 Base Bid Amount: **$0.00** (Lump Sum Bid); and

4.2 Accepted Alternates, included in the Contract Sum:

Alternate No.	Description	Amount
1	Additional time for Owner to execute Owner-Contractor Agreement	
2	Canton NW Water Treatment Plant ATI filtersmart controller system	
3	Canton NE Water Treatment Plant ATI filtersmart controller system	
4	18" through 42" PCCP C301 SP-5 finished water distribution main repair kits	
5	Painting of Filter Pipe Gallery (Room, 108, 108A & 108B), Connected Hallways and Stairwell E & F	
6	Roof Replacements	

4.3 Allowances included in the Contract Sum:

Allowance Description	Amount
Allowance #1: Concrete crack repairs and patching	____

Allowance #2: Sanitary sewer to septic tank pipe repair(s)	
Allowance #3: Landscaping	
Allowance #4: Plant signage	
Allowance #5: Laboratory equipment and office furniture	
Allowance #6: Vacant	
Allowance #7: Lagoon residual solids removal, hauling and disposal to an approved landfill	
Allowance #8: Pump service company (Wellfield)	
Allowance #9: Pump service company (High Service Pumps)	
Allowance #10: Additional process piping and valves	
Allowance #11: Additional building demolition and renovation	
Allowance #12: Additional demolition and renovation for general, HVAC, and plumbing	
Allowance #13: Additional demolition and renovation for electrical, instrumentation and control	
Allowance #14: Additional SCADA programming	
Allowance #15: Electric power company	
Allowance #16: Network hardware	

4.4 If after Substantial Completion of its Work, the Contractor fails to submit its final payment application with all the documents required to be submitted with such application within ninety (90) days after written notice to do so from the Owner and without prejudice to any other rights and remedies the Owner may have available to it, the balance of the Contract Sum shall become the Owner's sole and exclusive property, and the Contractor shall have no further interest in or right to such balance.

5. RETAINAGE. Retainage applicable to the Contract by Ohio Revised Code Sections 153.12, .13, and .14 will be withheld as defined in the Modified General Conditions. The Contractor agrees that the financial institution selected by the Owner for deposit of retained funds is acceptable to the Contractor and will sign any documents requested related to said account.

6. GENERAL.

6.1 MODIFICATION. No modification or waiver of any of the terms of this Agreement or of any other Contract Documents will be effective against a party unless set forth in writing and signed by or on behalf of a party. In the case of the Owner, the person executing the modification or waiver must have express authority to execute the Modification on behalf of the Owner pursuant to a resolution that is duly adopted by the Owner. Under no circumstances will forbearance, including the failure or repeated failure to insist upon compliance with the terms of the Contract Documents, constitute the waiver or modification of any such terms. The parties acknowledge that no person has authority to modify this Agreement or the other Contract Documents or to waive any of its or their terms, except as expressly provided in this section.

6.2 ASSIGNMENT. The Contractor may not assign this Agreement without the written consent of the Owner, which the Owner may withhold in its sole discretion.

6.3 LAW AND JURISDICTION. All questions regarding the validity, intention, or meaning of this Agreement or any modifications of it relating to the rights and obligation of the parties will be construed and resolved under the laws of the State of Ohio. Any suit, which may be brought to enforce any provision of this Agreement or any remedy with respect hereto, shall be brought in the Common Pleas Court of the county in which the Project is located and each party hereby expressly consents to the exclusive jurisdiction of such court to the exclusion of any other court, including any U.S. District Court or any other federal court.

6.4 CONSTRUCTION. The parties acknowledge that each party has reviewed this Agreement and the other Contract Documents and entered into this Agreement as a free and voluntary act. Accordingly, the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party will not be employed in the interpretation of this Agreement, the other Contract Documents, or any amendments or exhibits to it or them.

6.5 APPROVALS. Except as expressly provided herein, the approvals and determinations of the Owner and Engineer will be subject to the sole discretion of the respective party and be valid and binding on the Contractor, provided only that they be made in good faith, i.e., honestly. If the Contractor challenges any such approval or determination, the Contractor has the burden of proving that it was not made in good faith by clear and convincing evidence.

6.6 PARTIAL INVALIDITY. If any term or provision of this Agreement is found to be illegal, unenforceable, or in violation of any laws, statutes, ordinances, or regulations of any public authority having jurisdiction, then, notwithstanding such term or provision, this Agreement will remain in full force and effect and such term will be deemed stricken; provided this Agreement will be interpreted, when possible, so as to reflect the intentions of the parties as indicated by any such stricken term or provision.

6.7 COMPLIANCE WITH LAWS AND REGULATIONS. The Contractor, at its expense, will comply with all applicable federal, state, and local laws, rules, and regulations applicable to the Work, including but not limited to Chapter 4115 of the Ohio Revised Code and Sections 153.59 and 153.60 of the Ohio Revised Code, which prohibit discrimination in the hiring and treatment of employees, with respect to which the Contractor agrees to comply and to require its subcontractors to comply.

6.7.1 NON-DISCRIMINATION. Contractor agrees:

.1 That in the hiring of employees for the performance of Work under this Agreement or in any subcontract, neither the Contractor, subcontractor, or any person acting on behalf of either of them, shall by reason of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color discriminate against any citizen of the state in the employment of labor or workers who are qualified and available to perform the Work to which the employment relates.

.2 That neither the Contractor, subcontractor, nor any person acting on behalf of either of them shall, in any manner, discriminate against or intimidate any employee hired for the performance of Work under this Agreement on account of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color.

.3 That there shall be deducted from the amount payable to the Contractor by the Owner under this Agreement a forfeiture of twenty-five dollars ($25.00) as required by Ohio Revised Code Section 153.60 for each person who is discriminated against or intimidated in violation of this Agreement.

.4 That this Agreement may be canceled or terminated by the Owner and all money to become due hereunder may be forfeited for a second or subsequent violation of the terms of this section of this Agreement.

6.7.2 PREVAILING WAGE RATES. The Contractor and its subcontractors, regardless of tier, shall strictly comply with their obligation, if any, to pay their employees working on the Project site at the applicable prevailing wage rates for the type of work, including any changes thereto, pursuant to Ohio Revised Code Chapter 4115 or Davis Bacon rates and requirements.

6.7.3 **ETHICS.** By signing and entering into this agreement with the Owner, the Contractor represents that it is familiar with all applicable ethics law requirements, including without limitation Sections 102.04 and 3517.13 of the Ohio Revised Code, and certifies that it is in compliance with such requirements. The Contractor understands that failure to comply with the ethics laws is, in itself, grounds for termination of this contract and may result in the loss of other contracts with the Owner.

6.8 **JOB MEETINGS.** The Contractor or one of its representatives with authority to bind the Contractor will attend all job meetings. The Owner anticipates that job meetings will be scheduled on a weekly basis during construction or as needed. The Contractor will ensure that its Subcontractors also hold regular job meetings at which safety issues and job matters are discussed as these relate to the Work being performed. Job meetings include, but are not limited to, pre-construction meetings, weekly job meetings, weekly safety tool box meetings, and monthly safety meetings.

6.9 **PROPERTY TAX AFFIDAVIT.** The Contractor's affidavit given under Section 5719.024, Ohio Revised Code, is incorporated herein.

6.10 **WARRANTIES.** Notwithstanding anything to the contrary in the Contract Documents, including the Project Manual and Specifications, no warranties by Contractor shall be limited to any time shorter than the statute of limitations for written contracts in Ohio.

6.11 **CONTRACTOR ATTESTATIONS.**

.1 Contractor attests that it has not scaled these contract documents to determine quantities for bids, as Contractor has field verified and taken its own dimensions to determine the quantities for its bid.

.2 Contractor agrees that all the scales noted on the drawings are correct; so as to give it an "intent" of what is to be bid. Contractor has not relied on any other dimensions than what are noted in text and dimension lines.

.3 Contractor has thoroughly read the Contract Documents and has asked any and all questions it has on the intent of the scope of work, or supposed errors and omissions contained in these drawings, during the bid process and prior to signing this Agreement.

.4 Contractor will not be asserting a claim for additional time or money associated with the three issues listed above.

.5 Contractor believes it has accurately interpreted the Contract Documents and has asked for clarification and received satisfactory response for all items not thoroughly addressed or appeared to be conflicting in the Contract Documents and has found all stipulations and requirements contained in this Agreement are as stated in the bid specifications and are enforceable according to Ohio Law, including but not limited to the Owner's right of offset, and the Owner's right to assess liquidated damages for work not completed according to the milestones listed on the project schedule contained in the Contract Documents.

6.12 **ENTIRE AGREEMENT.** This Agreement and the other Contract Documents constitute the entire agreement among the parties with respect to their subject matter and will supersede all prior and contemporaneous, oral or written, agreements, negotiations, communications, representations, and understandings with respect to such subject matter, and no person is justified in relying on such agreements, negotiations, communications, representations, or understandings.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed by their properly authorized representatives and agree that this Agreement is effective as of the date first set forth above.

Owner:
The City of Canton

Contractor:
____

The City of Canton

By: _____

Name: _____

Title: _____

Date: _____

By: _____

Name: _____

Title: _____

Date: _____

CERTIFICATE
(Section 5705.41, R.C.)

The undersigned, fiscal officer of the Owner, certifies that the moneys required to pay that part of the Contract Sum coming due during the current fiscal year, under the Agreement to which this Certificate is attached have been lawfully appropriated for such purpose and are in the appropriate account of the Owner, or in the process of collection to the credit of the appropriate account or fund, free from any previous encumbrances. Moneys due in excess of the Contract Sum shall require an additional and separate Fiscal Officer's Certificate.

DATED: _____

_____
Fiscal Officer

BID GUARANTY AND CONTRACT BOND

(O.R.C. § 153.571)

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned _____ _____ ("Contractor") as principal and _____ _____ as surety are hereby held and firmly bound unto the **City of Canton** as obligee in the penal sum of the dollar amount of the bid submitted by the principal to the obligee on _____ _____, 20__, to undertake the construction of the **Sugar Creek Water Treatment Plant & Wellfield Improvements Project** ("Project"). The penal sum referred to herein shall be the dollar amount of the principal's bid to the obligee, incorporating any additive or deductive Alternates made by the principal on the date referred to above to the obligee, which are accepted by the obligee. In no case shall the penal sum exceed the amount of _____ Dollars ($_____ _____). (If the foregoing blank is not filled in, the penal sum will be the full amount of the principal's bid, including add Alternates. Alternatively, if the blank is filled in the amount stated must not be less than the full amount of the bid including add Alternates, in dollars and cents. A percentage is not acceptable.) For the payment of the penal sum well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

Signed this _____ day of _____, 20__.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH that whereas the above named principal has submitted a bid for work on the Project.

Now, therefore, if the obligee accepts the bid of the principal and the principal fails to enter into a proper contract in accordance with the bid, plans, details, specifications, and bills of material; and in the event the principal pays to the obligee the difference not to exceed ten percent (10%) of the penalty hereof between the amount specified in the bid and such larger amount for which the obligee may in good faith contract with the next lowest bidder to perform the work covered by the bid; or in the event the obligee does not award the contract to the next lowest bidder and resubmits the project for bidding, the principal pays to the obligee the difference not-to-exceed ten percent (10%) of the penalty hereof between the amount specified in the bid, or the costs, in connection with the resubmission, of printing new contract documents, required advertising, and printing and mailing notices to prospective bidders, whichever is less, then this obligation shall be null and void, otherwise to remain in full force and effect; if the obligee accepts the bid of the principal and the principal within ten (10) days after the awarding of the contract enters into a proper contract in accordance with the bid, plans, details, specifications, and bills of material, which said contract is made a part of this bond the same as though set forth herein.

Now also, if the said principal shall well and faithfully do and perform the things agreed by said principal to be done and performed according to the terms of said contract; and shall pay all lawful claims of subcontractors, materialmen, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; and surety shall indemnify the obligee against all damage suffered by failure of the principal to perform the contract according to its provisions and in accordance with the plans, details, specifications, and bills of material therefor and to pay all lawful claims of subcontractors, materialmen, and laborers for labor performed or material furnished in carrying forward, performing, or completing the contract and surety further agrees and assents that this undertaking is for the benefit of any subcontractor, materialman, or laborer having a just claim, as well as for the obligee; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions, or additions in or to the terms of the said contract or in or to the plans or specifications therefore shall in any wise affect the

obligations of said surety on its bond, and does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

Signed and sealed this _____ day of _____, 20__.

_____
PRINCIPAL

By: _____

Printed Name & Title: _____

_____
SURETY

By: _____

Printed Name & Title: _____

_____

Surety's Address: _____

_____

Surety's Telephone Number: _____

Surety's Fax Number: _____

_____
SURETY'S AGENT

Surety's Agent's Address: _____

_____

Surety's Agent's Telephone Number: _____

Surety's Agent's Fax Number: _____

NOTE: The Contract Bond form that follows is to be used ONLY by a bidder that is awarded a contract and submits a form of bid guaranty other than the combined Bid Guaranty and Contract Bond with its bid. If a bidder submits a combined Bid Guaranty and Contract Bond, then the bid guaranty becomes the contract bond when the contract is awarded.

AIA and EJCDC Bid Bond or Payment and Performance Bond forms are not acceptable for this Project.

The City of Canton

CONTRACT BOND
(O.R.C. § 153.57)

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned ("Contractor"), as principal, and _____, as surety, are hereby held and firmly bound unto the **City of Canton** ("Owner") as oblige, in the penal sum of _____ _____ Dollars ($_____ _____), for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH that whereas, the above-named principal did on the _____ day of _____, 20__, enter into a contract with the Owner for construction of the **Sugar Creek Water Treatment Plant & Wellfield Improvements Project** ("Project"), which said contract is made a part of this bond the same as though set forth herein:

Now, if the said Contractor shall well and faithfully do and perform the things agreed by the Contractor to be done and performed according to the terms of said contract; and shall pay all lawful claims of subcontractors, materialmen, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions, or additions in or to the terms of the said contract or in or to the plans or specifications therefore shall in any wise affect the obligations of said surety on its bond, and does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

Signed and sealed this _____ day of _____, 20__.

_____ (PRINCIPAL)

By: _____

Printed Name & Title:_____

_____

_____ (SURETY)

By: _____

Printed Name & Title:_____

_____

Surety's Address: _____

_____

Surety's Telephone Number:_____

Surety's Fax Number:_____

_____
NAME OF SURETY'S AGENT

Surety's Agent's Address: _____

_____

Surety's Agent's Telephone Number:_____

Surety's Agent's Fax Number:_____

SCOPE OF BIDS

CITY OF CANTON WATER DEPARTMENT

SUGAR CREEK WTP & WELLFIELD IMPROVEMENTS

It is understood and agreed that the Contractor has, by careful examination, understands the nature and location of the work; the conformation of the ground; the character, quality, and quantity of the materials to be encountered; the character or equipment and facilities needed preliminary to and during the prosecution of the work; the general and local conditions; local, state, and federal regulations; and all other matters which can, in any way, affect the nature of work specified under this Contract.

All known structures, pipelines, and utilities have been indicated in their approximate locations on the plans, and any material variation in size and location of structures and pipe shall not be cause for extra payment.

Major deviations or modifications during construction, from that shown on, or the true intent of, the plans and specifications requiring more or less labor and materials shall only be authorized by Change Order as approved by the Owner.

The Contractor shall verify the rating and horsepower of the equipment proposed to be furnished and shall provide for any necessary electrical changes to accommodate the equipment furnished at no additional cost to the Owner.

If construction procedures and equipment being utilized by the Contractor prove to be inadequate in the performance of the Contract, the procedures and equipment shall be modified or alternative equipment shall be furnished and used at no additional cost to the Owner.

No separate payment will be made for any item that is not specifically set forth in the Bid, and all costs therefore shall be included in the prices named in the Bid for the various Items of Work. Payment for each respective item shall include such general costs for submittals, samples, tools, coordination, machinery, and appliances necessary to complete the work as specified and in Contract Documents within the timeline specified.

The price Bid shall include, but not limited to, the following:

1) All incidental works specified and or shown on the drawings not included in other bid items. This includes but is not limited to project management, dewatering, construction sequencing, temporary facilitates, pre-construction video, shop drawings, operation and maintenance manuals, documentation, and final close out documents.
2) All tools, equipment, supplies, manufactured articles, labor, operations, and incidentals, supervision, layout and surveying, insurance, overhead [including field overhead (aka General Conditions costs) and home office overhead], applicable taxes, fees, and profit to complete the work as set forth in the Contract Documents.
3) Work also includes all costs of permits and cost of compliance with regulations of public agencies having jurisdiction, including Safety and Health Requirements of the State of Ohio and the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA).
4) All field staking and surveying necessary for construction shall be established by the Contractor to confirm the locations of all topographic features and underground utilities prior to construction activities.
5) All assistance required by the Owner to verify compliance with the Contract Documents, including measuring of quantities as specified herein.
6) All demolition debris removal, testing required by the Contractor, coordination with testing company hired separately by the Owner for Special Inspections, and other items as required by the Contract Documents.

All BIDDERS must Bid Items specified herein, and award of the Contract will be based on the Bidder's Qualifications as reviewed and approved by the Owner. The work type within this Contract is detailed below and provided for reference. Bidders shall refer to Contract Documents for the full scope and nature of the work to ensure the Bid Price provided for each item is fully inclusive. Contract Drawings shall govern if any discrepancy exists between the Contract Drawings and this document.

1) BID ITEM NO. 1: BONDING
   a) **Description.** The lump sum bid for this item shall include all bonding.
   b) **Payment.** Payment for Bonding will be made at the monthly rate of 1/30 of the lump sum price for bonding.

2) BID ITEM NO. 2: MOBILIZATION AND DEMOBILIZATION
   a) **Description.** The lump sum bid for this item shall include all necessary labor, tools, equipment, materials, and activities including but not limited to mobilizing, demobilizing, construction staging temporary facilities and utilities required during construction, and all other related work and expenses whether specifically mentioned or not, required for the completion of the bid items in accordance with the Contract Documents.
   b) **Payment.** Payment for mobilization will be made at the rate of 2/3 of the lump sump price bid for this item, to be paid under Contractor's first payment application, with the remaining 1/3 to be paid for demobilization with Contractor's final payment application.

3) BID ITEM NO. 3: WATER TREATMENT PLANT PROCESS, PLUMBING, HVAC, ELECTRICAL, AND INSTRUMENTATION & CONTROL IMPROVEMENTS THAT EXCLUDES ITEM 1, ITEM 2 AND ITEMS 4 THRU 41
   a) **Description.** The lump sum bid for this item shall include furnishing of all materials, labor, tools, and equipment necessary to perform all general civil/sitework, demolition, cleaning, structural, architectural, process, painting, plumbing work, mechanical, HVAC, electrical, instrumentation and control work complete and ready for operation in accordance with the Contract Documents. Removal of the existing underground storage tank (UST) will be accomplished by an UST Removal Contractor as detailed in Specification Section 33 56 13.
      i) Site Work. Is defined under this Bid Item to include all site work within the fence limits around the Water Treatment Plant and access drive. Refer to Contract Drawings for additional work not specifically mentioned herein.
         (1) Demolition and disposal of all concrete sidewalks, concrete pavement, concrete foundations, asphalt driveways, asphalt parking lots, and any other impervious area that requires removal. Installation of new impervious surfaces shall be handled by other Bid Items listed herein.
         (2) Full depth replacement of the access drive and parking lot that includes storm piping, storm headwalls, new signage, bollards, parking lot striping, bumper blocks, and concrete curbs as shown on Contract Documents.
         (3) Above ground fuel tank, fuel tank pad with foundation, fill station, all new piping, and coordination with the contractor separately hired by the Owner to perform removal of the existing storage tank.
         (4) Precast vault structures with access as shown on the Contract Documents.
         (5) Yard work shall include, but not limited to, excavation, removal of excess material, trenching, trench boxes, temporary earth retention systems, backfill, dust control and noise control. Additionally, work shall include the following.
            (a) Raw Water and Aerated Water piping, valving, fittings, and restrained joints for piping between 16-inches and 42-inches in diameter.
            (b) Storm and Sanitary piping and fittings up to 8-inches in diameter.
            (c) Roof drain piping, fittings, and splash block installation to direct away from the washwater lagoons.
            (d) Plant water piping, fittings, valving, and hydrants.
            (e) Installation of frost slabs, yard steps, French drains, and manholes.
            (f) Modification to existing manholes and vaults that includes removal of existing piping and valves and installation of new.

(g) Miscellaneous piping, pipe abandonment, pipe restraint, and pipe encasement.

(h) Stormwater pollution prevention plan (SWPPP), temporary gravel, and site restoration.

(6) Demolition shall include, but not limited to, removal and proper disposal of existing asphalt pavement, concrete pavement, concrete curb, concrete sidewalk, an underground storage tank, existing fencing and gates, gate operators, curb, pipe removal, and pipe abandonment as shown on the Contract Drawings.

(7) Restoration shall include removal and replacement of signage, grading and seeding as shown on the Contract Drawings. Landscaping only will be covered by a separate allowance.

ii) Electrical and Instrumentation & Control. Work shall include all the electrical work, all power wiring, HVAC and plumbing conduit and wiring, instrumentation and controls, conduit and wiring, motor and equipment connections, transformers, electric service, and all else required to complete the electrical work specified in Division 26 and Division 40 Instrumentation, Section 40 90 00 through Section 40 95 33.06, in accordance with the Contract.

(1) The bid price shall include all excavation and backfill for electrical conduits, cutting and patching existing concrete, inserts in the concrete, pull boxes, manholes, demolition, and testing of electrical equipment installed under this Contract, supplying temporary utilities as required for proper execution of this Contract.

iii) HVAC. Work shall include all the HVAC systems for the various structures as shown on the drawings, specified herein, or implied, complete and operational. The work shall include all heating and air conditioning units, unit heaters, duct work, duct insulation, pipe and fittings, grilles, diffusers, louvers, shutters, fans, controls, tie-ins, gas connection at each unit, cutting and patching of existing structures, demolishing, and all else necessary for a complete and operable system.

iv) Washwater Reservoir. Work shall include, but not limited to, removal of existing piping and valving and installation of new, connection to the backwash system of each filter, and additional piping to drain the reservoir through the filter-to-waste pump. Refer to Contract Drawings for additional work not specifically mentioned herein.

v) Maintenance Garage. Removal and replacement of the overhead door, replacement of HVAC equipment and appurtenances, and new oil separator connected to the floor drain. Refer to Contract Drawings for additional work not specifically mentioned herein.

vi) West Aerator Building. Work shall include, but not limited to replacement of the existing roof and concrete planks, removal and cleaning of the existing screens and framing, replacement of the aerator distribution trays and supports, removal and installation of piping, replacement of existing valves, rerouting of roof drains, removal of the existing chlorine feed point and interior piping, replacement of HVAC equipment and appurtenances, new wall hydrants, refurbishment of the existing masonry that includes pressure washing, new valve actuators (e.g., floor stands, extended bonnets, and motor actuated), new concrete floor topping, replacement of landings, and replacement of stairs. Refer to Contract Drawings for additional work not specifically mentioned herein.

vii) East Aerator Building. Work shall include, but not limited to removal and cleaning of the existing screens and framing, replacement of the aerator distribution trays and supports, removal and installation of piping, replacement of existing valves, rerouting of roof drains, replacement of HVAC equipment and appurtenances, new wall hydrants, refurbishment of the existing masonry that includes pressure washing, and new valve

actuators (e.g., floor stands, extended bonnets, and motor actuated). Refer to Contract Drawings for additional work not specifically mentioned herein.

viii) Main Building. Work shall include, but not limited to the following. Refer to Contract Drawings for additional work not specifically mentioned herein.

(1) Removal of the curtain wall system and masonry knee wall on the outside face of the building and removal of the glazed tile partition abutting the High Service Pump Station Room inside.

(2) Removal of the existing spiral staircase and installation of a new elevator and sump pump.

(3) Removal and replacement of existing doors, windows, skylights, bathroom plumbing and fixtures, handrails, roof access hatches, and staircases.

(4) Removal and replacement of the existing surface water, plant water, emergency eyewash and showers, backflow preventors, pressure reducing valves, cold and hot water piping, hot water heater, and wall hydrants.

(5) Rerouting existing roof drains to the storm sewer and installation of new floor drains and trench drains.

(6) Modifications to the existing walls that includes inspection, mortar & joint repair, pressure washing, demolition, core drilling, and construction of new.

(7) Installation of new piping, and valves within the clearwell and modification to construct the three (3) clearwell chambers and two (2) chlorine contact tanks.

(8) Replacement of the existing fluoride day tank, tote scale, all interior piping and appurtenances, and three (3) new peristaltic metering pumps.

(9) Installation of new analyzers for both chlorine and fluoride as shown on the contract drawings with new diffusers and new surface water connections as shown on the Contract Drawings.

(10) Replacement of the existing chlorinators, distribution panels, and all interior piping and appurtenances. The chlorine cylinder storage room and chlorinator room shall include chlorine gas analyzers that are interlocked with the room exhaust fan.

(11) For the high service pumps, removal of one (1) existing motor and replacement with a variable frequency drive (VFD) and three (3) existing synchronous motors to be cleaned, reconditioned, and bearings replaced.

(12) For the filters, removal and replacement of the existing media, replacement of underdrains or refurbishment of underdrains via jetting, cleaning of the existing troughs, adjustment of the existing weirs, and new air supply piping and supports.

(13) Removal of two (2) existing washwater pumps and replacement with one (1) washwater pump that is interconnected with the surface wash, backwash to each filter, and the washwater reservoir.

(14) Replacement of the filter-to-waste pump, piping, and valving that will discharge to the washwater lagoons.

(15) Removal of existing valving, fittings, and piping and replacement and installation with new as shown in the Contract Drawings. Valving shall include, but not limited to, floor stands, extended bonnets, and motor actuated valves.

(16) Cleaning of the designated lagoon used during construction after completion of the project. The drained and dewatered residual solids in the lagoons are removed to an approved landfill as described in Bid Item No. 27.

(17) Installation of two (2) new positive displacement blowers with piping, valves, fittings, and other appurtenances to each filter cell.

(18) Installation, wiring, and connection to SCADA of twelve (12) ATI Filter Smart Controller Systems Backwash Analyzer to each of the filters.

(19) Replacement of all HVAC equipment that includes, but not limited to, louvers, unit heaters, ductwork, air transfer system, and exhaust fans. Work to also include the removal of the hot water baseboard heaters.

(20) Installation of vaults for surge relief, raw water meter vaults, and other vaults shown on the Contract Drawings that includes, but not limited to, access manholes, excavation, temporary earth retention system, backfill, blocking, joint material, joint restraints valving, and spare wrenches.

ix) Tank & Channel Cleaning: This item shall include pressure washing of the ceiling, floors, and walls and removal of the residual solids from WTP structures as required to perform the work. This item shall also include dewatering of the tank and/or to the top of the sediment layer. Tank cleaning shall be as specified in Section 02 61 20 Tank and Channel Cleaning. Work related to this item shall include, but not be limited to, labor, tools, and equipment necessary to remove remaining sediment, loadout (via roll-off boxes, tanker trucks, or dump trucks), and unload residual solids from cleaning operations as directed into the lagoon selected by the Owner.

x) Start up, commissioning, final acceptance, operational demonstration, and all other related work and expenses whether specifically mentioned or not, required for the completion of the Water Treatment Plant in accordance with the Contract Documents.

b) **Measurement.** The successful Bidder will be required to furnish a breakdown of the lump sum bid as required for estimating purposes.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

4) BID ITEM NO. 4: WELLFIELD WELL PUMPS, PROCESS, PLUMBING, HVAC, ELECTRICAL, AND INSTRUMENTATION & CONTROL IMPROVEMENTS THAT EXCLUDES ITEMS 1 THRU 3 AND ITEMS 5 THRU 41

a) **Description.** Include all well pump, process, plumbing, HVAC, electrical, and instrumentation and control work from the Well Pump casing pipe to the connection tee to both the New Raw Water Main described under Bid Item 4 and Existing Raw Water Main Described under Bid Item 5. Refer to Contract Drawings for additional work not specifically mentioned herein. Work includes, but not limited to, the following:

i) Removal of existing gravel driveways as called out on Contract Drawings.

ii) Refurbishment of existing well pumps and motors.

iii) Removal of the existing 12-inch steel pump discharge, fittings, and appurtenances to the existing raw water main.

iv) Demolition and/or abandonment of existing concrete valve vaults and piping that includes backfill as specified.

v) Installation of new pipe, fittings, flow meters, valves, and thrust blocks as shown on the Contract Drawings.

vi) Installation of well support systems for the well pump and motor.

vii) Installation of foundation and new well buildings including metal siding, roof panels, doors, hardware, and louvers.

viii) Electrical and Instrumentation & Control. Work shall include all the electrical work, all power wiring, HVAC and plumbing conduit and wiring, instrumentation and controls, conduit and wiring, motor and equipment connections, transformers, electric service, and all else required to complete the electrical work specified in Division 26 and Division 40 Instrumentation, Section 40 90 00 through Section 40 95 33.06, in accordance with the Contract.

(1) The bid price shall include all excavation and backfill for electrical conduits, cutting and patching existing concrete, inserts in the concrete, pull boxes, manholes, demolition, and testing of electrical equipment installed under this

Contract, supplying temporary utilities as required for proper execution of this Contract.

ix) HVAC. Work shall include all the HVAC systems for the various structures as shown on the drawings, specified herein, or implied, complete and operational. The work shall include all heating and air conditioning units, unit heaters, duct work, duct insulation, pipe and fittings, grilles, diffusers, louvers, shutters, fans, controls, tie-ins, gas connection at each unit, cutting and patching of existing structures, demolishing, and all else necessary for a complete and operable system.

b) **Measurement.** The successful Bidder will be required to furnish a breakdown of the lump sum bid as required for estimating purposes.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

5) BID ITEM NO. 5: WELLFIELD NEW RAW WATER TRANSMISSION MAIN THAT EXCLUDES ITEMS 1 THRU 4 AND ITEMS 6 THRU 41

a) **Description.** Include all work associated with the New Raw Water Transmission Main that concludes at the Water Treatment Plant fence line. All proposed work located within the Sugar Creek WTP fence limits shall be included in Bid Item 2. Refer to Contract Drawings for additional work not specifically mentioned herein. Work includes, but not limited to, the following:

i) This item shall include, but not limited to, all necessary labor, vehicles, materials, equipment, mobilization, power, notifications, coordination, excavation and backfill, trenching, temporary earth retention system, trench boxes, preparation of trench bottom, noise control, dust and odor control, daily cleanup, utility pole support, utility relocation or support, utility protection, sign removal and replacement, and SWPPP, bypass pumping as required, and all other related items and expenses.

ii) Preconstruction work shall include utility verification, locating and staking of proposed water main alignment, clearing, tree protection, grubbing, replacement or protection of landscaping, and stump removal as required to complete the work.

iii) Installation of new pipe, fittings, valves, manholes, restrained joints, and thrust blocks.

iv) Jack and bore work under U.S. State Route 21 that includes, but not limited to, a launching pit, receiving pit, spacers, steel casing, and other items detailed in Contract Documents.

v) Placement and compaction of fill to remove the low point in grade between Wellfield No. 2 and Wellfield No. 3 above the proposed alignment.

b) **Measurement.** The successful Bidder will be required to furnish a breakdown of the lump sum bid as required for estimating purposes.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

6) BID ITEM NO. 6: WELLFIELD EXISTING RAW WATER TRANSMISSION MAIN, CLEANING, AND SOLIDS DISPOSAL THAT EXCLUDES ITEMS 1 THRU 5 AND ITEMS 7 THRU 41

a) **Description.** Include all work associated with the Existing Raw Water Main that concludes at the Water Treatment Plant fence line. All proposed work located within the Sugar Creek WTP fence limits shall be included in Bid Item 3. Refer to Contract Drawings for additional work not specifically mentioned herein. Work includes, but not limited to, the following:

i) This item shall include, but not limited to, all necessary labor, vehicles, materials, equipment, mobilization, power, notifications, coordination, excavation and backfill, trenching, temporary earth retention system, trench boxes, preparation of trench bottom, noise control, dust and odor control, daily cleanup, utility pole support, utility relocation or support, utility protection, sign removal and replacement, and SWPPP as

shown on the Drawings, bypass pumping if required, and all other related items and expenses.

ii) Inspection of the existing precast cylinder concrete pipe (PCCP) with a closed-circuit television (CCTV) and submit a draft report to Owner for review of findings, recommendations, and proposed cleaning methodology to remove scale and sediment. Once the draft is reviewed and approved by the Owner, Contractor shall finalize and complete cleaning of the pipeline. Base bids shall assume 4-inches of scale and sediment around the circumference of the existing PCCP raw water main and proper disposal to the designated lagoon.

iii) Removal of existing PCCP from the raw water main and installation of proposed doghouse manholes with new piping that connects to existing.

iv) Installation of tapping sleeves to install the new well pump 12-inch discharge piping to the existing raw water main.

v) Installation of new pipe, fittings, valves, and thrust blocks as shown on the Contract Drawings.

b) **Measurement.** The successful BIDDER shall be required to furnish a breakdown of the lump sum bid as required for bidding purposes.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

7) BID ITEM NO. 7: DECHLORINATION FACILITY COMPLETE THAT EXCLUDES ITEMS 1 THRU ITEM 6 AND ITEMS 8 THRU 41

a) **Description.** Include all work associated with the new Dechlorination Facility that will be is located near the existing lagoons. The lump sum bid for this item shall include furnishing of all materials, labor, tools, and equipment necessary to perform all general civil/sitework, demolition, cleaning, structural, architectural, process, painting, plumbing work, mechanical, HVAC, electrical, instrumentation and control work complete and ready for operation in accordance with the Contract Documents.

b) **Measurement.** The successful BIDDER shall be required to furnish a breakdown of the lump sum bid as required for bidding purposes.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

8) BID ITEM NO. 8: ADDITIONAL REINFORCED CONCRETE WORK

a) **Description.** This unit price stipulated for this item shall include furnishing and placing of all additional reinforced concrete necessary above what is shown on the Contract Drawings. The unit price shall include furnishing, forming, and placing the reinforced concrete when directed by the Engineer.

b) **Measurement.** Actual ODOT 613 LSM material in place and accepted by the Owner.

c) **Payment.** Will be made on a cubic yard basis on the quantity determined in the field from the measurements specified above.

9) BID ITEM NO. 9: ADDITIONAL RAW WATER 12-INCH PIPING BETWEEN WELL BUILDING AND TEE CONNECTION ON RAW WATER MAINS

a) **Description.** This item includes any additional 12-inch pipe required to be installed between the proposed Well Building and the tee connection between the two (2) raw water mains which will be based on the location of the existing PCCP raw water main joint. Work shall include, but not limited to, to the following:

i) All necessary labor, vehicles, materials, equipment, mobilization, power, notifications, coordination, excavation and backfill, trenching, temporary earth retention system, trench boxes, preparation of trench bottom, noise control, dust and odor control, daily

cleanup, utility pole support, utility relocation or support, utility protection, bypass pumping as required, and all other related items and expenses.

ii) Installation of new pipe, fittings, valves, manholes, restrained joints, and thrust blocks as shown on the Contract Drawings.

b) **Measurement.** Actual amount of excess pipe required to complete the interconnect between the two (2) raw water mains based on the location of the existing PCCP joint location that is not accounted for in Contract Drawings.

c) **Payment.** Will be made in linear feet of additional pipe installed in the field and as authorized by the Owner.

10) BID ITEM NO. 10: ADDITIONAL EXCAVATION AND HAULING

a) **Description.** This item includes any additional excavation and hauling of material to a designated on-site location over and above what is shown on the Contract Drawings or included in other bid items. Work shall include, but not limited to, to the following:

i) All necessary labor, vehicles, materials, equipment, mobilization, power, notifications, coordination, excavation and backfill, trenching, temporary earth retention system, trench boxes, preparation of trench bottom, noise control, dust and odor control, daily cleanup, utility pole support, utility relocation or support, utility protection, and all other related items and expenses.

b) **Measurement.** Actual amount of additional cubic yards of excavation measured by the Contractor and approved/verified by the Owner/Engineer.

c) **Payment.** Will be made on a cubic yard basis on the quantity determined in the field from the measurements specified above. Unauthorized excavation below grade or beyond what is specified shall be at the cost of the Contractor at no additional cost to the Owner.

11) BID ITEM NO. 11: ADDITIONAL COMPACTED FOUNDATION

a) **Description.** The unit price stipulated for this item shall include the furnishing and placing of all compacted granular material necessary to backfill the trench under pavements and driveways over and above what is shown on the Contract Drawings; disposal of excavated material, subgrade preparation and protection; and the furnishing, placing, and compaction of fill material when directed by the Engineer.

b) **Measurement.** Will be made on a cubic yard basis based on the actual compacted foundation material in place, completed, and accepted within the limits authorized by the Engineer.

c) **Payment.** Will be made on a cubic yard basis on the quantity determined in the field from the measurements specified above. Unauthorized excavation below grade or beyond what is specified shall be at the cost of the Contractor at no additional cost to the Owner.

12) BID ITEM NO. 12: ADDITIONAL GRANULAR BACKFILL ODOT 304

a) **Description.** This unit price stipulated for this item shall include furnishing and placing of all granular backfill necessary to backfill the trench under pavements and driveways over and above what is shown on the Contract Drawings; disposal of excavated material, subgrade preparation and protection; and the furnishing, placing, and placing granular backfill when directed by the Engineer.

b) **Measurement.** Actual ODOT 304 limestone base material in place, compacted, and accepted within the limits authorized by the Owner.

c) **Payment.** Will be made on a cubic yard basis on the quantity determined in the field from the measurements specified above. Unauthorized excavation below grade or beyond what is specified shall be at the cost of the Contractor at no additional cost to the Owner.

13) BID ITEM NO. 13: ADDITIONAL STRUCTURAL BACKFILL ODOT 703.11

a) **Description.** This unit price stipulated for this item shall include furnishing and placing of all structural backfill necessary to backfill the trench under pavements and driveways over and above what is shown on the Contract Drawings; disposal of excavated material, subgrade preparation and protection; and the furnishing, placing, and placing structural backfill when directed by the Engineer.

b) **Measurement.** Actual ODOT 703.11 material in place, compacted, and accepted the Owner.

c) **Payment.** Will be made on a cubic yard basis on the quantity determined in the field from the measurements specified above. Unauthorized excavation below grade or beyond what is specified shall be at the cost of the Contractor at no additional cost to the Owner.

14) BID ITEM NO. 14: ADDITIONAL BEDDING AND BACKFILL ODOT 603

a) **Description.** This unit price stipulated for this item shall include furnishing and placing of all bedding and backfill necessary to backfill the trench under pavements and driveways if field conditions require use of this material; disposal of excavated material, subgrade preparation and protection; and the furnishing, placing, and placing bedding and backfill when directed by the Engineer.

b) **Measurement.** Actual ODOT 603 material in place, compacted, and accepted and authorized by the Owner.

c) **Payment.** Will be made on a cubic yard basis on the quantity determined in the field from the measurements specified above. Unauthorized excavation below grade or beyond what is specified shall be at the cost of the Contractor at no additional cost to the Owner.

15) BID ITEM NO. 15: ADDITIONAL LSM BEDDING AND BACKFILL ODOT 613

a) **Description.** This unit price stipulated for this item shall include furnishing and placing of all LSM backfill necessary to backfill the trench under pavements and driveways if field conditions require use of this material; disposal of excavated material, subgrade preparation and protection; and the furnishing and placing LSM backfill when directed by the Engineer.

b) **Measurement.** Actual ODOT 613 LSM material in place and accepted by the Owner.

c) **Payment.** Will be made on a cubic yard basis on the quantity determined in the field from the measurements specified above. Unauthorized excavation below grade or beyond what is specified shall be at the cost of the Contractor at no additional cost to the Owner.

16) BID ITEM NO. 16: PAVEMENT, ASPHALT

a) **Description.** This item shall include fine grading of the subgrade, final compaction, furnishing, spreading, and compacting the aggregate base material; furnishing and applying the prime coat; furnishing, installing, and compacting the asphaltic surface material; and all other items required to complete the driveways and parking areas asphalt surface installation in accordance with the Contract Documents. Demolition and disposal of existing asphalt pavement shall be included in Bid Item 3 for work within the WTP and Access Drive Area and Bid Item 4 if otherwise.

b) **Measurement.** Actual amount of asphalt surface placed and accepted.

c) **Payment.** Will be made on a square yard basis on the quantity determined in the field from the measurements specified above. Unauthorized construction of the driveway widths beyond those established by the Owner will not be eligible for payment and shall be at the expense of the Contractor.

17) BID ITEM NO. 17: CONCRETE SIDEWALK

a) **Description.** This item shall include excavation; furnishing, placing, and compacting the aggregate base; furnishing, forming, finishing, and curing the concrete; and all other items required to construct the concrete sidewalks in accordance with the Contract Documents or as

directed by the Owner. Demolition and disposal of existing concrete shall be included in Bid Item 3 for work within the WTP and Access Drive Area and Bid Item 4 if otherwise.

b) **Measurement.** Actual amount of sidewalk placed and accepted by the Owner.

c) **Payment.** Will be made on a square foot basis on the quantity determined in the filed from the measurements specified above. Unauthorized construction of walkway widths beyond those established by the Owner will not be eligible for payment and shall be at the expense of the Contractor.

18) BID ITEM NO. 18: NEW CHAIN LINK FENCE AND ENTRANCE GATE AT WTP

a) **Description.** This item shall include clearing and fine grading as necessary; furnishing and installing all fencing materials, barbed wire, gates, hardware, posts, gate actuators, and anchor concrete; and all other items required to complete the chain link fence installation at the WTP in accordance with the Contract Documents. Chain link fence and gates required at wellfield in accordance with the Contract Documents shall be included in Item 4.

b) **Measurement.** Actual amount of fence constructed and accepted

c) **Payment.** Will be made on a lineal foot basis on the quantity determined in the field from the measurements specified above through the gates for chain link fence.

19) BID ITEM NO. 19: REMOVE AND REINSTALL EXISTING CHAIN LINK FENCE

a) **Description.** This item shall include the removal and reinstallation of the chain link fence, barbed wire, gates, gate operators, hardware, posts, anchor concrete, and all other related items. Fencing and appurtenances shall also be disposed of properly as called out on Contract Drawings.

b) **Measurement.** Actual amount of existing fence removed, reinstalled and accepted.

c) **Payment.** Will be made on a lineal foot basis on the quantity determined in the field from the measurements specified above through the gates for chain link fence.

20) BID ITEM NO. 20: ADDITIONAL REMOVAL AND REPAIR OF EXISTING CONCRETE

a) **Description.** The unit price stipulated for this item shall include labor, tools and equipment necessary to patch or repair existing concrete surfaces, as specified in Section 03 01 73 “Concrete Repair” over and above what is shown on the Contract Drawings.

b) **Measurement.** Actual number of square feet of concrete patching or repair performed assuming a nominal 4-inch partial depth removal/repair of the existing concrete surface, complete as authorized by the Owner.

c) **Payment.** Will be made on a square foot basis on the quantity determined in the field from the measurements specified above.

21) BID ITEM NO. 21: ALLOWANCE 1 - CONCRETE CRACK REPAIRS AND PATCHING

a) **Description.** This item shall include payment for work involving repair and patching existing concrete that is not accounted for on Contract Drawings.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work. Any unspent money shall be deducted from the total contract.

c) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

22) BID ITEM NO. 22: ALLOWANCE 2 - SANITARY SEWER TO SEPTIC TANK PIPE REPAIR(S)

a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment for additional sanitary sewer not accounted for on Contract Drawings.

b) **Measurement.** All work shall be authorized in advance and any unspent money shall be deducted from the total contract.

c) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner.

d) **Measurement.** All work shall be authorized by the Owner in advance of the work

e) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

23) BID ITEM NO. 23: ALLOWANCE 3 - LANDSCAPING

a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment for additional landscaping that is not included in the Contract Documents and requested by the Owner.

b) **Measurement.** All work shall be authorized in advance of the work.

Payment. This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

24) BID ITEM NO. 24: ALLOWANCE 4 - PLANT SIGNAGE

a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form to cover payment of the project plaque, exterior signage at the main entrance and on the new elevator shaft, additional signage for room names, equipment signage, and signage for OSHA compliance that is not included in the Contracted Documents and requested by the Owner. The masonry wall at the plant entrance shall be included in Bid Item No. 3.

b) **Measurement.** All work shall be authorized in advance of the work.

Payment. This item must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

25) BID ITEM NO. 25: ALLOWANCE 5 - LABORATORY EQUIPMENT AND OFFICE FURNITURE

a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form to cover the payment of all materials, labor, and equipment necessary to furnish laboratory furniture, office computer desks, chairs, file cabinets, as shown on the drawings, and as chosen by the Owner.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** Contractor to provide a unit price for labor on the Bid Form to procure and deliver to job site freight on board (F.O.B.), unload, store, assemble, and install the equipment. The bid allowance for material shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

26) BID ITEM NO. 26: ALLOWANCE 7 - LAGOON RESIDUAL SOLIDS REMOVAL, HAULING, AND DISPOSAL TO AN APPROVED LANDFILL

a) **Description.** Removal of the drained and dewatered residual solids in the lagoons that includes, but not limited to, labor, tools, and equipment necessary to remove, deliver, weigh-in, and unload residual solids from cleaning operations as directed to an approved landfill after completion of the project. The residual solids removed shall be required to meet the sampling requirements of the approved landfill. Only the final cleaning of the designated lagoon used during construction shall be included in Bid Item No. 3.

b) **Measurement.** All work shall be authorized by the Owner and Engineer in advance of the work.
c) **Payment.** This item must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

27) BID ITEM NO. 27: ALLOWANCE 8 - PUMP SERVICE COMPANY (Wellfield)
a) **Description.** This item shall include a lump sum allowance as specified on the Bid for payment to Ohio Drilling Company to rehabilitate the ten (10) Wellfield Pumps as detailed in Specification 43 21 14.01 and Appendix IV.
b) **Measurement.** All work shall be authorized by the Owner in advance of the work.
c) **Payment.** This item must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

28) BID ITEM NO. 28: ALLOWANCE 9 - PUMP SERVICE COMPANY (High Service Pumps)
a) **Description.** This item shall include a lump sum allowance as specified on the Bid for payment to Ohio Drilling Company to rehabilitate the five (5) High Service Pumps as detailed in Specification 43 21 14.02 and Appendix IV.
b) **Measurement.** All work shall be authorized by the Owner in advance of the work.
Payment. This item must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

29) BID ITEM NO. 29: ALLOWANCE 10 – ADDITIONAL PROCESS PIPING AND VALVES
a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment as required due to additional process piping and repair or replacement of existing valves based on actual field conditions.
b) **Measurement.** All work shall be authorized by the Owner in advance of the work.
Payment. This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

30) BID ITEM NO. 30: ALLOWANCE 11 - ADDITIONAL BUILDING DEMOLITION AND RENOVATION
a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment as required due to changes in conditions or revisions based on actual field conditions or alternative equipment furnished by the Contractor.
b) **Measurement.** All work shall be authorized by the Owner in advance of the work.
Payment. This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

31) BID ITEM NO. 31: ALLOWANCE 12 - ADDITIONAL DEMOLITION AND RENOVATION FOR GENERAL, HVAC, AND PLUMBING
a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment as required due to changes in conditions or revisions based on actual field conditions or alternative equipment furnished by the Contractor.
b) **Measurement.** All work shall be authorized by the Owner in advance of the work.
c) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by

Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

32) BID ITEM NO. 32: ALLOWANCE 13 - ADDITIONAL DEMOLITION AND RENOVATION FOR ELECTRICAL, INSTRUMENTATION AND CONTROL

a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment as required due to changes in conditions or revisions based on actual field conditions or alternative equipment furnished by the Contractor.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

33) BID ITEM NO. 33: ALLOWANCE 14- ADDITIONAL SCADA PROGRAMMING

a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment for additional programming as requested by the Owner within the Process Control Systems over and above what is shown on the Contract Drawings.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

34) BID ITEM NO. 34: ALLOWANCE 15 - ELECTRIC POWER COMPANY

a) **Description.** This item shall include a lump sum allowance as specified on the Bid Form for payment of charges due to the Electrical Power Company related to the installation and coordination of new electrical service to the Wastewater Treatment Plant by the electrical company. This item shall also include an allowance for payment of additional work approved and performed over and above what is specified in the Contract Documents, shown on the Drawings, or actual field conditions encountered.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more or less than the allowance. Any unspent money shall be deducted from the total contract.

35) BID ITEM NO. 35: ALLOWANCE 16 - NETWORK HARDWARE

a) **Description.** This item shall include an allowance as specified on the Bid Form for payment of network hardware that may be requested by the Owner.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** This item is over and above what is described in the Contract Documents and must be based on written proposals approved by the Owner. The allowance shall be adjusted by Change Order if the final cost is more than the allowance. Any unspent money shall be deducted from the total contract.

36) BID ITEM NO. 36: ALTERNATE 1 – ADDITIONAL TIME FOR OWNER TO EXECUTE OWNER-CONTRACTOR AGREEMENT

a) **Description.** Due to funding requests and required funding approvals, the Owner does not anticipate an award within 60 days of the bid opening. The unit price bid for this item shall include the sum of all of the Bidder's direct and indirect costs and reasonable overhead

attributable to delay, for each day beyond sixty days after bid opening that Owner fails to execute the Owner-Contractor Agreement based upon Bidder's bid provided in response to this Invitation to Bid.

b) **Measurement.** Actual number of days beyond sixty days after bid opening that Owner fails to execute the Owner-Contractor Agreement.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

37) BID ITEM NO. 37: ALTERNATE 2 - CANTON NW WTP ATI FILTERSMART CONTROLLER SYSTEM

a) **Description.** The unit price stipulated for this item shall include the procurement of materials, installation, wiring, and connection to SCADA of four (4) ATI Filter Smart Controller Systems Backwash Analyzer to each of the filters.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

38) BID ITEM NO. 38: ALTERNATE 3 - CANTON NE WTP ATI FILTERSMART CONTROLLER SYSTEM

a) **Description.** The unit price stipulated for this item shall include the procurement of materials, installation, wiring, and connection to SCADA of eight (8) ATI Filter Smart Controller Systems Backwash Analyzer to each of the filters. Refer to Specification Section

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

39) BID ITEM NO. 39: ALTERNATE 4 - 18-INCH THROUGH 42-INCH PCCP C301 SP-5 FINISHED WATER DISTRIBUTION MAIN REPAIR KITS

a) **Description.** Furnish, coordinate delivery, and acceptance of shipment for Finished Water Distribution Main Repair Kits to be stored at a location selected by the Owner. This location may not be at the Sugar Creek WTP. Finished Water Distribution Main Repair Kits with white epoxy for future distribution main breaks that includes a set of repair bands, tapping saddle with blind flange, closure piece 8-feet in length with double spigot adapters and short pipe segment, and one lay length of pipe segment that is 16-feet in length for the following pipe sizes:

i) 18-inch SP-5 Class 100
ii) 20-inch SP-5 Class 100
iii) 24-inch SP-5 Class 100
iv) 30-inch SP-5 Class 100
v) 42-inch SP-5 Class 175

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

40) BID ITEM NO. 40: ALTERNATE 5 – PAINTING OF FILTER PIPE GALLERY (ROOM 108, 108A, & 108B), CONNECTED HALLWAYS, AND STAIRWELL E & F.

a) **Description.** Surface preparation, painting, and finishing of exposed interior surfaces. Surface preparation, priming, and finish coats as specified in Section 09 90 00 for the Filter Gallery (Room 108, 108A, & 108B), hallways between Filter #5 and #6 with Filters #1 through #4, and the entirety of Stairwell E & F.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.

c) **Payment.** Payment will be made at the unit price bid for this bid item.

BID ITEM NO. 41: ALTERNATE 6 – ROOF REPLACEMENTS

a) **Description.** This item shall include all necessary labor, vehicles, materials, equipment, mobilization, power, notifications, coordination, and all other related work, fees, items and

expenses, whether specifically or not, required for completing the roof replacements for the following buildings:

i) Filter #5 and #6 Addition: 2,900 SF
ii) Maintenance Garage: 1,500 SF
iii) Chlorine Building: 1,640 SF
iv) Fluoride Building: 680 SF
v) Generator Building: 580 SF
vi) East Aerator: 1,840 SF

The work included consists of removal and replacement of the membrane roofs for the building defined above. The existing roof shall be removed to the existing deck. The Contractor shall coordinate all flashing around existing and new roof penetrations, existing or new hatches, and any new or existing roof top units. Existing roof top units shall be disconnected and removed as required to install new roofing and the units shall be reinstalled. The new roof shall be a singly ply membrane roof complete with new tapered insulation per current Ohio Building Code, flashing, fasteners, and fascia and shall be furnished and installed in compliance with Division 07. The Contractor shall coordinate with the roof system manufacturer to ensure all conditions of the newly installed roofing meets warranty requirements. The roof replacement shall meet current Ohio Building Code, IBC 2015, IEBC 2015 and all regulatory requirements referenced in Division 07. The roofs shall be designed/installed to provide positive draining to existing drains per approved shop drawings. All roofing transitions shall be in accordance with manufacturer's standard details or the NRCA Roofing Manual. The new roof shall be installed on the existing roof deck; any deck repair will be approved and paid for under a separate allowance item. Railing systems as required per Pipe and Tube Railings Section 05 52 13 shall be included in the base bid. The cost of this item shall include the credit to the Owner for the patching or flashing shown on the plans to be included in the base bid that would be non-performed if this alternate is selected. If accepted, the Contractor shall provide a breakdown of the lump sum price for the credits used for this bid item.

b) **Measurement.** All work shall be authorized by the Owner in advance of the work.
c) **Payment.** Payment will be made at the unit price bid for this bid item.

BID FORM

1.01 BID SUBMITTED BY:

_____
(Contractor)

Date bid submitted: _____

1.02 DELIVER TO:

The City of Canton
ATTN: **Purchasing/Bids**
218 Cleveland Avenue SW
Canton, OH 44702

1.03 Having carefully reviewed the Instructions to Bidders, Drawings, Specifications and other Contract Documents for the Project titled **Sugar Creek Water Treatment Plant & Wellfield Improvements Project** including having also received, read, and taken into account the following Addenda:

Addendum No.	Dated
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

and likewise having inspected the site and the conditions affecting and governing the Project, the undersigned hereby proposes to furnish all materials and to perform all labor, as specified and described in the said Specifications and/or as shown on the said Drawings for all Work necessary to complete the Project on a timely basis and in accordance with the Contract Documents regardless of whether expressly provided for in such Specifications and Drawings.

1.04 Before completing the Bid Form, the undersigned represents that it has carefully reviewed the Legal Notice to Bidders, Instructions to Bidders, this Bid Form, Form of Bid Guaranty and Contract Bond, Contractor's Affidavit (O.R.C. 5719.042), Owner-Contractor Agreement, General Conditions of the Contract (EJCDC C-700) (as modified for the Project), Drawings, Project Specifications, and other Contract Documents. Failure to comply with provisions of the Contract Documents may be cause for disqualification of the bid.

1.05 BONDS AND CONTRACT: If the undersigned is notified of bid acceptance, it agrees to furnish required bonds as indicated in the Instructions to Bidders.

1.06 COMPLETION OF WORK: In submitting a bid, the undersigned agrees to execute the Owner-Contractor Agreement in the form included in the Contract Documents and to complete its Work as required by the Contract Documents.

NOTE A: The wording of the Bid Form shall be used throughout, without change, alteration, or addition. Any change may cause it to be rejected.

NOTE B: Bidder is cautioned to bid only on the Brands or Standards specified.

NOTE C: If there is an inconsistency or conflict in the Bid amount, the lowest amount shall control, whether expressed in numbers or words.

2.01 BID:

Include the cost of all labor and material for the contract listed below. Bidder is to fill in all blanks related to the Bid Package for which a bid is being submitted. If no bid is submitted for an item, leave the item blank or insert "NO BID" in the blank. For alternate items, indicate whether the amount stated is in addition to or a deduction from the base bid amount (if there is no indication whether the amount for an alternate is an addition or a deduction, the amount shall be a deduction).

2.02 Bidder will complete the Work in accordance with the Contract Documents for the prices set forth in the attached Bid Schedule.

3.01 INSTRUCTIONS FOR SIGNING

A. The person signing for a sole proprietorship must be the sole proprietor or his authorized representative. The name of the sole proprietor must be shown below.

B. The person signing for a partnership must be a partner or his authorized representative.

C. The person signing for a corporation must be the president, vice president or other authorized representative; or he must show authority, by affidavit, to bind the corporation.

D. The person signing for some other legal entity must show his authority, by affidavit, to bind the legal entity.

4.01 BIDDER CERTIFICATIONS. The Bidder hereby acknowledges that the following representations in this bid are material and not mere recitals:

1. **The Bidder acknowledges that this is a public project involving public funds, and that the Owner expects and requires that each successful Bidder adhere to the highest ethical and performance standards. The Bidder by submitting its bid pledges and agrees that (a) it will act at all times with absolute integrity and truthfulness in its dealings with the Owner and the Design Professional, (b) it will use its best efforts to cooperate with the Owner and the Design Professional and all other Contractors on the Project and at all times will act with professionalism and dignity in its dealings with the Owner, Design Professional and other Contractors, (c) it will assign only competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks that are assigned to him/her, and (d) it has read, understands and will comply with the terms of the Contract Documents.**

2. The Bidder represents that it has had a competent person carefully and diligently review each part of the Contract Documents, including any Divisions of the Specifications and parts of the Drawings that are not directly applicable to the Work on which the Bidder is submitting its bid. By submitting its bid, each Bidder represents and agrees, based upon its careful and diligent review of the Contract Documents, that it is not aware of any conflicts, inconsistencies, errors or omissions in the Contract Documents for which it has not notified the Owner in writing at least ten (10) days prior to the bid opening. If there are any such conflicts, inconsistencies, errors or omissions in the Contract Documents, the Bidder (i) will provide the labor, equipment or materials of the better quality or greater quantity of Work; and/or (ii) will comply with the more stringent requirements. The Bidder will not be entitled to any additional compensation for any

conflicts, inconsistencies, errors or omissions that would have been discovered by such careful and diligent review, unless it has given such prior written notice to Owner.

3. The Bidder represents that it has had a competent person carefully and diligently inspect and examine the entire site for the Project and the surrounding area, including all parts of the site applicable to the Work for which it is submitting its bid, and carefully correlate the results of the inspection with the requirements of the Contract Documents. The Bidder agrees that its bid shall include all costs attributable to site and surrounding area conditions that would have been discovered by such careful and diligent inspection and examination of the site and the surrounding area, and the Bidder shall not be entitled to any Change Order, additional compensation, or additional time on account of conditions that could have been discovered by such an investigation.

4. The Bidder represents, understands and agrees that a) the Claim procedures in the General Conditions as modified for the Project are material terms of the Contract Documents, b) if it has a Claim, it will have its personnel provide complete and accurate information to complete and submit the Statement of Claim form on a timely basis, c) the proper completion and timely submission of a Statement of Claim form is a condition precedent to any change in the Contract Sum or the Contract Time(s), and d) the proper and timely submission of the Statement of Claim form provides the Owner with necessary information so that the Owner may investigate the Claim and mitigate its damages.

5. The Bidder represents that the bid contains the name of every person interested therein and is based upon the Standards specified by the Contract Documents.

6. The Bidder and each person signing on behalf of the Bidder certifies, and in the case of a bid by joint venture, each member thereof certifies as to such member's entity, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the Base Bid, any Unit Prices and any Alternate bid in the bid have been arrived at independently without collusion, consultation, communication or agreement, or for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices or Alternate bid; (c) no attempt has been made or will be made by the Bidder to induce any other Person to submit or not to submit a bid for the purpose of restricting competition; and (d) the statements made in this Bid Form are true and correct.

7. The Bidder will execute the form of Owner/Contractor Agreement in the form included with the Contract Documents, if a Contract is awarded on the basis of this bid, and if the Bidder does not execute the Contract Form for any reason, other than as authorized by law, the Bidder and the Bidder's Surety are liable to the Owner.

8. The Bidder certifies that the upon the award of a Contract, the Contractor will ensure that all of the Contractor's employees, while working on the Project site, will not purchase, transfer, use or possess illegal drugs or alcohol or abuse prescription drugs in any way.

9. The Bidder agrees to furnish any information requested by the Owner's authorized representative to evaluate that the Bidder has submitted the lowest and best bid and that the bid is responsive to the specifications.

10. The Bidder certifies that it has no unresolved findings for recovery issued by the Auditor of State.

11. The Bidder certifies that it is aware of and in compliance with the requirements of Ohio Revised Code Section 3517.13 regarding campaign contributions.

LEGAL NAME OF BIDDER: _____

BIDDER IS (check one): __ sole proprietor __ partnership __ corporation __ other legal entity

NAME & TITLE OF PERSON LEGALLY AUTHORIZED TO BIND BIDDER TO A CONTRACT:

_____
Name Title

DATE SIGNED: _____ SIGNATURE: _____

ADDRESS: _____

_____

TELEPHONE: _____

FAX: _____

FEDERAL TAX I.D. # _____

When the Bidder is a partnership or a joint venture, state name and address of each partner in the partnership or participant in the joint venture below:

_____ _____

_____ _____
Name

_____
Address

_____ _____

_____ _____
Name

_____
Address

_____ _____

_____ _____
Name

_____
Address

_____ _____

_____ _____
Name

_____
Address

_____ _____

_____ _____
Name

_____
Address

END OF SECTION

MANUFACTURERS OF MATERIAL AND EQUIPMENT TO BE FURNISHED

City of Canton, Ohio
Water Department
Sugarcreek Water Treatment Plant
& Wellfield Improvements

Specific equipment has been used in preparing the CONTRACT DOCUMENTS, establishing a minimum quality that is acceptable. The BIDDER must prepare its Base BID on equipment manufacturers listed below. The manufactures listed below is not a complete list of all equipment needed for the project; the BIDDER is responsible for reviewing the CONTRACT DOCUMENTS for all equipment required for a complete project. For Base BID equipment items that have only one manufacturer listed, that manufacturer's equipment shall be included in the Base BID. For Base BID equipment items that have more than one manufacturer listed, the BIDDER is required to indicate by an "X" in the spaces ( ) provided, the equipment proposed to be furnished as part of the Base BID. One "X" and one "X" only shall be entered for each separate Base BID category of material or equipment.

In addition to the BIDDERS selecting a BASE BID equipment item, BIDDERS may quote on alternative equipment by listing it under "Alternate Bid Equipment" for each separate category of material or equipment identified as a Base BID item. The BIDDER shall indicate its alternates by inserting the manufacturer's name in the space provided and inserting the dollar amount (in figures) in the column labeled "Deduct From Base BID." The BIDDER shall indicate the dollar amount for each alternate listed and shall include all money required to incorporate the alternate into the PROJECT.

The BID will be reviewed based on the Base BID equipment submitted. Alternative equipment will be reviewed after the BID is submitted as part of the submittal review process. The OWNER reserves the right to accept or reject any of the alternates proposed and if so, the BIDDER shall then supply equipment from one of the Base BID manufacturers identified on the list (in writing, and prior to the project is awarded and contract executed).

Each BIDDER is required to follow these directions. Any bidding form that is submitted not in compliance with these directions may be rejected by the OWNER and that BID not considered in determining award.

BIDDERS must complete all items.

Specification Section	Manufacturer of Equipment or Material	Deduct From Base Bid
06 80 01	**Composite Fabrications for Baffle Walls**	
	( ) a. Strongwell	
	( ) b. MFG Laminating Group	
	( ) c. Enduro Composites	
	( ) d. NEFCO	
	Alternate Bid Equipment	
	( ) f. _____	_____
14 24 02	**Limited Use Limited Application (LULA) Elevator**	
	(X) a. Savaria, Brampton, ON, Canada	
	Alternate Bid Equipment	
	( ) b. _____	_____
26 12 00	**Medium Voltage Transformers**	
	( ) a. ABB Power Company, Inc.	
	( ) b. Cooper Power Systems	
	( ) c. Eaton, Cutler Hammer	
	( ) d. General Electric Co.	
	Alternate Bid Equipment	
	( ) e. _____	_____
26 13 00	**Medium Voltage Switchgear**	
	(X) a. Eaton, Cutler Hammer	
	Alternate Bid Equipment	
	( ) b. General Electric Co.	
	( ) c. Siemens Energy & Automation, Inc.	
	( ) d. _____	_____
26 18 39	**Medium Voltage Motor Control Center**	
	(X) a. Eaton, Cutler Hammer	
	Alternate Bid Equipment	
	( ) b. General Electric Co.	
	( ) c. Siemens Energy & Automation, Inc.	
	( ) d. _____	_____
26 22 00	**Low Voltage Transformers**	
	Transformers	
	( ) a. Eaton, Cutler Hammer	
	( ) b. General Electric Co.	
	( ) c. Siemens Energy & Automation, Inc.	
	Alternate Bid Equipment	
	( ) e. _____	_____

Specification Section	Manufacturer of Equipment or Material	Deduct From Base Bid
26 24 01	**Service Entrance**	
	Meter Sockets	
	( ) a. Circle AW Products Co.	
	( ) b. Duncan Electric Co Inc.	
	( ) c. Federal Pacific Electric Co.	
	( ) d. General Electric Co.	
	( ) e. GTE Sylvania Inc.	
	( ) f. Square D Co.	
	Alternate Bid Equipment	
	( ) g. _____	_____
26 24 13	**Low Voltage Switchboard**	
	( ) a. Eaton, Cutler Hammer	
	( ) b. General Electric Co.	
	( ) c. Siemens.	
	Alternate Bid Equipment	
	( ) d. _____	_____
26 24 16	**Panelboards**	
	( ) a. Eaton, Cutler Hammer	
	( ) b. General Electric Co.	
	( ) c. Siemens	
	Alternate Bid Equipment	
	( ) d. _____	_____
26 24 19	**Low Voltage Motor Control Centers**	
	(X) a. Eaton, Cutler Hammer	
	Alternate Bid Equipment	
	( ) b. Allen Bradley	
	( ) c. General Electric Co.	
	( ) d. Siemens.	
	( ) e. _____	_____
26 29 00	**Low Voltage Motor Controllers**	
	(X) a. Eaton, Cutler Hammer	
	Alternate Bid Equipment	
	( ) b. Allen Bradley	
	( ) c. General Electric Co.	
	( ) d. Siemens.	
	( ) e. _____	_____

Specification Section	Manufacturer of Equipment or Material	Deduct From Base Bid
28 16 00	**Closed Circuit Television Systems** ( ) a. Tyco Illustra Pro Gen Series ( ) b. Hanwha Wisenet X Series Alternate Bid Equipment ( ) c. _____	_____
40 05 23	**Process Valves** Electric Operators (X) a. Auma Alternate Bid Equipment ( ) b. Rotork IQ Multi-turn or IQT Quarter Turn Valves ( ) c. Limitorque ( ) d. E.I.M. ( ) e. _____ Ball Check Valves with Electric Hydraulic Operator (X) a. Val-matic Valve and Manufacturing Corp Ener-G Ball Valve and Electric-Hydraulic Operator Alternate Bid Equipment ( ) b. Henry Pratt Company Ball Check Valve Diagnostic Electro-Check ( ) c. _____	_____ _____
40 91 00	**Analytical Instruments** Gravity Filter Backwash Monitoring System (X) a. Analytical Technology Inc. Alternate Bid Equipment ( ) b. _____	_____
40 95 33	**System Integrator/ Instrumentation Contractor** (X) a. Dublin Tech Alternate Bid Equipment ( ) b. Dmytryka Jacobs Engineers ( ) c. RoviSys Building Technologies ( ) d. Commerce Controls Inc. ( ) e. _____	_____
41 22 23.13	**Bridge Cranes** ( ) a. ACCO Industries Inc. ( ) b. Yale Alternate Bid Equipment ( ) c. _____	_____

Specification Section	Manufacturer of Equipment or Material	Deduct From Base Bid
41 22 23.16	**Portable Davit Cranes**	
	( ) a. Thern, Inc. USA, Winona, MN	
	( ) b. Grainger Industrial Supply, Lake Forest, IL	
	( ) c. Halliday Products, Orlando, FL	
	Alternate Bid Equipment	
	( ) d. _____	_____
43 11 33	**Blowers, Positive Displacement**	
	(X) a. Universal Blower Pac	
	Alternate Bid Equipment	
	( ) b. Aerzen USA	
	( ) c. Dresser Roots Blowers	
	( ) d. Excelsior Blower Systems	
	( ) e. Gardner Denver	
	( ) f. _____	_____
43 21 00	**Pumps, General**	
	Motor	
	( ) a. U.S. Motors	
	( ) b. Reliance Electric/Baldor	
	Alternate Bid Equipment	
	( ) c. _____	_____
43 21 10	**Pumps, Nonclog**	
	( ) a. Cornell	
	( ) b. Fairbanks Nijhuis	
	( ) c. Flowserve	
	( ) d. ITT/AC	
	( ) e. Yeomans	
	Alternate Bid Equipment	
	( ) f. _____	_____
43 21 14.01	**Pumps, Vertical Turbine Pump Rehabilitation for the Wellfield Pumps**	
	Pump Service Company	
	(X) a. Ohio Drilling Company	
	Alternate Bid Equipment	
	( ) b. _____	_____
43 21 14.02	**Pumps, Vertical Turbine Pump Rehabilitation for the High Service Pumps**	
	Pump Service Company	
	(X) a. Ohio Drilling Company	
	Alternate Bid Equipment	
	( ) b. _____	_____

Specification Section	Manufacturer of Equipment or Material	Deduct From Base Bid
43 24 13	**Pumps, Vertical Turbine**	
	( ) a. American Marsh.	
	( ) b. Simflow	
	( ) c. Fairbanks Nijhuis.	
	( ) d. Floway.	
	( ) e. Flowserve.	
	( ) f. Peerless.	
	Alternate Bid Equipment	
	( ) g. _____	_____
44 43 50.03	**Filter Equipment**	
	(X) a. Roberts Filter Manufacturing Company	
	Alternate Bid Equipment	
	( ) b. _____	_____
46 31 11	**Chlorine Gas Feed Equipment**	
	(X) a. Wallace and Tiernan	
	Alternate Bid Equipment	
	( ) b. _____	_____
46 33 01	**Liquid Chemical Feed Equipment**	
	Peristaltic Metering Pumps	
	( ) a. Blue White	
	( ) b. Watson-Marlow	
	( ) c. Vector	
	( ) d. Masterflex	
	( ) e. Eccentric	
	Alternate Bid Equipment	
	( ) f. _____	_____

The City of Canton

CONTRACTOR'S QUALIFICATION STATEMENT

Sugar Creek Water Treatment Plant & Wellfield Improvements Project

SUBMITTED TO: The City of Canton
ATTN: **Purchasing/Bids**
218 Cleveland Avenue SW
Canton, OH 44702

SUBMITTED BY: _____

NAME: _____

ADDRESS: _____
_____
_____

PRINCIPAL OFFICE: _____
_____

☐ Corporation

☐ Partnership

☐ Individual

☐ Joint Venture

☐ Other

NAME OF PROJECT: Sugar Creek Water Treatment Plant & Wellfield Improvements Project

1. ORGANIZATION

1.1 How many years has your organization been in business as a Contractor in the construction industry?

1.2 How many years has your organization been in business under its present business name?

1.2.1 Under what other or former names has your organization operated?

1.3 If your organization is a corporation, answer the following:

1.3.1 Date of incorporation:

1.3.2 State of incorporation:

1.3.3 President's name:

1.3.4 Vice President's name(s):

1.3.5 Secretary's name:

1.3.6 Treasurer's name:

1.4 If your organization is a partnership, answer the following:

1.4.1 Date of organization:

1.4.2 Type of partnership (if applicable):

1.4.3 Name(s) of general partner(s):

1.5 If your organization is individually owned, answer the following:

1.5.1 Date of organization:

1.5.2 Name of owner:

1.6 If the form of your organization is other than those listed above, describe it and name the principals:

2. LICENSING

2.1. List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable.

2.2. List jurisdictions in which your organization's partnership or trade name is filed.

2.3. List any suspension or revocations of any professional license of any director, officer, owner, or managerial employees of the Contractor, to the extent that any work to be performed on this Project is within the field of such licensed profession.

3. EXPERIENCE

3.1. List the categories of work that your organization normally performs with its own forces.

3.2. Claims and Lawsuits (If the answer to any of the questions below is yes, please attach details.)

3.2.1. Has your organization ever failed to complete any work?

3.2.2. Has your organization ever failed to complete any work by the substantial completion date, final completion date, or in a timely manner?

3.2.3. Within the last five (5) years has your organization or any of its officers prosecuted any Claims, had any Claims prosecuted against it or them, or been involved in or is currently involved in any mediation or arbitration proceedings or lawsuits related to any construction project, or has any judgments or awards outstanding against it or them? Has your organization had any extension requests, fines and penalties imposed, or contract defaults? If the answer is yes, please attach the details for each Claim, including the names and telephone numbers of the persons who are parties, the amount of the Claim, the type of Claim and the basis for the Claim, and the outcome.

Note: As used in this document "Claim" means a Claim initiated under the Contract Documents for a project or relating to the Work for a project, including Claims made against performance bonds secured by the Contractor on other construction projects.

3.3. Has your organization ever failed to comply with federal, state, and local laws, rules, and regulations, including but not limited to the Occupational Safety and Health Act, the Ohio Prevailing Wage laws, and Ohio ethics laws? If the answer is yes, please attach details and reason(s) for each instance and the outcome including any fines or penalties imposed.

3.4. Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? If the answer is yes, please attach details for each instance, including the names and telephone numbers of the persons who are parties to the contract, and the reason(s) the contract was not completed.

3.5. On a separate sheet, list construction projects your organization has in progress with an original Contract Sum of more than $10,000,000, giving the name of project, owner and its telephone number, design professional and its telephone number, contract amount, percent complete and scheduled completion date.

3.5.1. State total amount of work in progress and under contract:

3.6. Provide the following information for each contract your organization has had during the last five (5) years, including current contracts, where the Contract Sum is fifty percent (50%) or more of the bid amount for this Project, including add alternates. Include details regarding timeliness of performance and quality of work. List the original contract price for each project, the amount of any change orders or cost overruns on each, the reasons for the change orders or cost overruns, and your organization's record for complying with and meeting completion deadlines on construction projects. If there are more than ten (10) of these contracts, only provide information on the most recent ten (10) contracts, including current contracts.

Project And Work	Contract Sum	Owner's Representative & Telephone Number	Engineer's Or Architect's Representative Name & Telephone Number	Additional Comments

3.7. Provide the following information for each project your organization has had during the last five (5) years, which your organization believes is of comparable or greater size and complexity than the Owner's project. Include details regarding how such projects demonstrate your organization's ability and capacity to perform a substantial portion of the Project with its own work force. If there are more than five (5) of these projects, only provide information on the most recent five (5) projects, including current projects.

Project And Work	Contract Sum	Owner's Representative & Telephone Number	Engineer's Or Architect's Representative Name & Telephone Number	Additional Comments

3.7.1. State average annual amount of construction work your organization has performed during the last five years.

3.7.2. If any of the following members of your organization's management -- president, chairman of the board, or any director -- operates or has operated another construction company during the last five (5) years, identify the member of management and the name of the construction company.

3.7.3. If your organization is operating under a trade name registration with the Secretary of State for the State of Ohio, identify the entity for which the trade name is registered. If none, state "none."

3.7.4. If your organization is a division or wholly-owned subsidiary of another entity or has another relationship with another entity, identify the entity of which it is a division or wholly-owned subsidiary or with which it has another relationship and also identify the nature of the relationship. If none, state "not applicable."

3.8. On a separate sheet, list the construction education, training, construction experience, and tenure with your organization for each person who will fill a management role on the Project, including without limitation the Project Executive, Project Engineer, Project Manager, and Project Superintendent. For each person listed, include with the other information the last three projects on which the person worked and the name and telephone number of the Design Professional and the Owner.

3.9. Describe the size and experience of your organization's work force and your equipment and facilities, in relation to your organization's ability to complete the Project successfully and on time.

4. REFERENCES

4.1. Trade References:

4.2. Bank References:

4.3. Surety:

4.3.1. Name of bonding company:

4.3.2. Name and address of agent:

5. FINANCING

5.1 Financial Statement **(May be required, but only post-bid. Not a requirement to provide with bid.)**

5.1.1 Attach a financial statement, preferably audited, including your organization's latest balance sheet and income statement showing the following items:

Current Assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses);

Net Fixed Assets;

Other Assets;

Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes); and

Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

5.1.2 Name and address of firm preparing attached financial statement, and date thereof.

5.1.3 Is the attached financial statement for the identical organization named on page one?

5.1.4 If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidiary).

5.2 Will the organization whose financial statement is attached act as guarantor of the contract for construction?

5.3 Attach additional documentation or explanations demonstrating your organization's financial responsibility, adequate resources and availability of credit, its means and ability to procure insurance and acceptable performance bonds required for the Project.

6. Does your organization participate in a drug-free workplace program? Provide your organization's record for both resolved and unresolved findings of the Auditor of the State of Ohio for recovery as defined in Section 9.24 of the Ohio Revised Code.

7. List any projects within the previous five years where a public entity determined that your organization was not a responsible bidder, including the name of the public entity, the reasons given by the public entity, and an explanation thereof.

8. Additional Criteria. Pursuant to the Codified Ordinance of the City of Canton, Chapter 105, the Owner, in its discretion, reserves the right to request additional information and documentation relating to the foregoing and related to any of the criteria listed in Paragraph I.6 of the Instructions to Bidders from Bidders after the bid opening. The Owner may consider such information and documentation in determining which bid is lowest and best. The Owner, in its discretion, may consider and give such weight to any and all criteria as it deems appropriate.

[left intentionally blank]

Certification. The undersigned certifies for the reliance of the Owner that after diligent investigation, to the best of the undersigned's belief, the information provided with this Contractor's Qualification Statement is true, accurate and not misleading.

SIGNATURE:

Dated this _____ day of _____ 20____.

Name of Organization: _____

By: _____
[print name]

Signature: _____

Title: _____

State of _____

County of _____

_____, being duly sworn, deposes and says that the information provided herein is true and sufficiently complete so as not to be misleading.

Subscribed and sworn before me this _____ day of _____ 20__.

_____
Notary Public

My Commission Expires:_____

SEAL

Modified General Conditions (EJCDC)

Please go to this link for the document or enter the following link information into a web browser:

https://cantonohio.gov/DocumentCenter/View/596/Modified-Standard-General-Conditions-of-the-Construction-Contract---3rd-Party-Engineer

ODOT MANUAL SUPPLEMENT

This Supplement shall apply where and to the extent that the State of Ohio Department of Transportation Construction and Material Specifications, in the current version as of January 1, 2019, is expressly incorporated into the Contract Documents via the Owner-Contractor Agreement, or when designated as a Contract Document in the list of Contract Documents in the Owner-Contractor Agreement, or is referenced anywhere else in the Contract Documents as one of the Contract Documents.

1. **Regardless of any terms to the contrary in Division 100 or elsewhere, any directions or orders of the Engineer that will result in an adjustment of the Contract Price or the Contract Time shall require the prior written approval of the Owner. It is expressly understood and agreed that the Engineer does not have authority to authorize changes or modifications in the Contract Price or Contract Time.**

2. The Contractor's obligations under this ODOT Supplement are in addition to and not in limitation of its other obligations under the Contract Documents.

3. Delays. Regardless of the terms in this ODOT Supplement, including Item 109.05, all time adjustments shall be subject to a) filing a Change Proposal and / or Claim in accordance with Articles 11 and 12 of the Modified Standard General Conditions **of the Contract for Construction (EJCDC C-700, 2013 edition) ("Modified Standard General Conditions"), b)** substantiating the Contractor's entitlement to a time adjustment in accordance with the Modified Standard General Conditions and c) Item 109.05. The Contractor will be entitled to additional compensation for delays but only for those delays described in the Modified Standard General Conditions. As part of the Claims process and as a condition precedent to receiving any additional compensation, the Contractor shall prepare a cost analysis as allowed by Item 109.05.D substantiating its entitlement to additional compensation.

4. Division 100, General Provisions. The following Division 100 General Provisions of the State of Ohio Department of Transportation, Construction Specifications Manual in the current version as of January 31, 2019, are incorporated in this ODOT Supplement, subject to any changes or limitations herein.

a. **Item 101.01**, General.

b. Item 101.02, Abbreviations, provided that references to DCA, DDD, DET, DGE shall mean the Owner.

c. Item 101.03, Definitions, provided where terms that are defined in the other Contract Documents, the definition in the other Contract Documents shall control, and further provided that the following definitions are deleted, modified and/or added:

i. Claims is deleted

ii. Contract Bond is deleted.

iii. Contract Documents is deleted.

iv. Contract Price is deleted.

v. Contract Time is deleted.

vi. Contractor is deleted.

vii. Department shall mean the Owner.

viii. Director shall mean the Owner's representative.

ix. Disputes is deleted.

x. Engineer is deleted.

xi. Extra Work Contract is deleted.

xii. Final Acceptance shall mean Final Completion as defined in the Owner Contractor Agreement.

xiii. Final Inspector shall mean the Owner.

xiv. Laboratory is deleted.

xv. Prebid Question is deleted.

xvi. Proposal Guaranty is deleted.

xvii. Questionnaire is deleted.

xviii. Shop Drawings is deleted.

xix. Signatures on Contract Documents is deleted.

xx. State or state shall mean the Owner.

xxi. Subcontractor is deleted.

xxii. Work is deleted.

d. **Item 101.04, Interpretations.**

e. Item 103.03, Cancellation of Award.

f. Item 104.02.D.2, Significant Changes in the Character of the Work (including Tables 104.02-1 and 104.02-2 following this Item), provided that all references to Item 108 and 109.12 are deleted and that all time adjustments shall be subject to filing a Change Proposal and / or Claim in accordance with the Modified Standard General Conditions and substantiating the entitlement to an extension of time as provided in the Modified Standard General Conditions (EJCDC Document C-700, 2013 edition) (“Modified Standard General Conditions”).

g. Item 104.03, Rights in and Use of Materials Found on the Work.

h. Item 104.04, Cleaning Up.

i. Item 105.02, Plans and Working Drawings, provided that the review of submittals may be by the Owner or the Engineer in the Owner’s discretion.

j. Item 105.06, Superintendent.

k. Item 105.10, Inspection of Work.

l. Item 105.11, Removal of Defective and Unauthorized Work.

m. Item 105.12, Load Restrictions.

n. Item 105.13, Haul Roads, provided that the second paragraph in this Item is deleted. The Contractor shall be responsible for any damage to the roads referred to in the second paragraph.

o. Item 105.14, Maintenance During Construction, except substitute “Final Completion” for “Final Inspector accepts the work under 109.12” and delete the remainder of the first sentence. Additionally, delete the second to last sentence in this Item.

p. Item 105.15, Failure to Maintain Roadway or Structure.

q. Item 105.16, Borrow and Waste Areas.

r. Item 105.17, Construction and Demolition Debris.

s. Item 106.01, Source of Supply and Quality Requirements.

t. Item 106.02, Samples, Tests and Cited Specifications, provided that this Item will be optional at the discretion of the Owner. If the Owner elects to proceed under this Item, a) the Contractor

without additional cost will provide material samples as required by the Owner, and b) the Owner may conduct such tests as it determines proper.

u. **Item 106.03, Small Quantities and Materials for Temporary Application.**

v. Item **106.04, Plant Sampling and Testing Plan.**

w. **Item 106.05, Storage of Materials.**

x. **Item 106.06, Handling Materials.**

y. **Item 106.07, Unacceptable Materials, except substitute the word "unacceptance" in the third sentence with the word "unacceptable."**

z. Item 106.08, **Department-Furnished Material.**

aa. **Item 106.09, Steel and Iron Products Made in the United States.**

bb. **Item 107.01, Laws to be Observed.**

cc. **Item 107.02, Permits, Licenses, and Taxes.**

dd. **Item 107.03, Patented Devices, Materials, and Processes.**

ee. **Item 107.05, Federal-Aid Provisions.**

ff. **Item 107.06, Sanitary Provisions.**

gg. **Item 107.07, Public Convenience and Safety.**

hh. **Item 107.08, Bridges Over Navigable Waters.**

ii. Item **107.09, Use of Explosives, provided that both bringing explosives onto the site and any use of explosives shall require the prior written approval of the Owner.**

jj. Item **107.10, Protection and Restoration of Property, provided that the Contractor shall remain responsible for** all damage and injury to property until the Project is Finally Complete, and all references to Items 109.11 and 109.12 are deleted.

kk. Item **107.11, Contractor's Use of the Project Right-of-Way or Other Department-Owned Property, provided the reference to Item 109.12 is deleted.**

ll. Item **107.12, Responsibility for Damage Claims and Liability Insurance, provided that all notices and certificates shall be delivered to the Owner's representative and, if there is no Owner's representative, to the Engineer. Reference to the "**State of Ohio, Department of Transportation" shall mean the Owner.

mm. Item **107.13, Reporting, Investigating, and Resolving Motorist Damage Claims, provided that this item is modified to read, "**When a motorist reports damage to its vehicle either verbally or in writing to the Contractor, the Contractor shall within 3 days make and file a written report to the Owner and the Engineer and also file a report with its insurance carrier".

nn. Item **107.14** Opening **Sections of Project to Traffic, provided that the reference to Item 108.06 is deleted.**

oo. Item **107.15, Contractor's Responsibility for Work, provided that reference to "**Final Inspection according to 109.12.A" shall mean "Final Completion." and all references to Item 108 are deleted.

pp. Item **107.17, Furnishing Right-of-Way.**

qq. Item **107.19, Environmental Protection, provided that the Owner makes no representation as to having acquired any permits unless expressly provided in the Contract Documents. The Contractor will comply with any permits obtained by the Owner.**

rr. Item **107.20, Civil Rights.**

ss. Item **107.21, Prompt Payment.**

tt. **with information or reports on DBE participation unless the Contract Documents otherwise require such reports or information. Additionally, unless otherwise provided in the Contract Documents, the 50% self-contracting requirement in the first sentence is waived.**

uu. Item **108.04, Limitation of Operations.**

vv. Item **108.05, Character of Workers, Methods, and Equipment.**

ww. Item **108.10, Payroll Records.**

xx. Item 109.01, Measurement of Quantities, provided that this item will apply only where payment is to be based on the measurement of quantities.

yy. Item 109.02, Measurement Units.

zz. Item 109.03, Scope of Payment.

aaa. Item **108.01, Subletting of the Contract, provided that the Contractor need not provide the Owner** (Reserved.)

bbb. Item 109.05, Extra Work as modified in this Supplement, provided that a) the references to Items 105.07, 105.10 and 108 are deleted, b) all negotiated prices shall require the Owner's written approval, c) the Owner must approve in writing any directions or orders by the Engineer to proceed with force account work, d) in Item 109.05.B.2 the reference to Department shall mean the Ohio Department of Transportation, e) the compensation provided in 109.05.B through 109.05.D constitutes payment in full for all the items referred to in Items 109.05.C.1-10, except for any additional compensation for delays, f) the mark-ups provided in Items 109.05.D.2.b and 109.05.D.2.d are deleted, and g) Item 109.05.D.2.f regarding home office overhead is deleted. The Contractor's entitlement to home office overhead, if any, shall be subject to current Ohio law.

ccc. **109.06, Directed Acceleration.**

ddd. **(Reserved.)**

eee. **109.08, Unrecoverable Costs.**

5. Divisions 200 through 700. Divisions 200 through 700 of the State of Ohio Department of Transportation, Construction Specifications Manual in the current version as of January 31, 2019 are incorporated in this ODOT Supplement.

a. All references to Division 100 Items in Divisions 200 through 700 shall be to the Division 100 Items as modified in this Supplement.

b. Where Division 100 Items are referred to in Divisions 200 through 700 but are not included in this Supplement, the deleted references will be governed by this Paragraph 5.

c. In Item 203.04, the reference to Item 108.06 shall be governed by Paragraph 3, Delays, in this Supplement.

d. In Item 514.24, the reference to Item 109.10 shall be governed by the payment provisions in the Modified Standard General Conditions.

e. In Item 624.04, the reference to item 109.09 shall be governed by the payment provisions in the Modified Standard General Conditions, i.e., the Owner will process and make payments in accordance with the provisions in the Modified Standard General Conditions. In this regard, the basis for payment of mobilization costs will be as provided in Item 624.04.

f. General to Divisions 200 through 700. The basis for payment provided in the Basis for Payment items in these Divisions shall be the basis for payment to the Contractor when applicable.

END OF ODOT SUPPLEMENT

City of Canton Codified Ordinances

Bidders shall take notice that they are to comply with the Codified Ordinances of the City of Canton, including but not limited to, the following:

1. **Chapter 105.02 – Public Paving Time Restrictions.**
   All City public paving contracts shall include a provision for liquidated damages in order to provide the City reasonable compensation for actual damages due to a failure to ensure that asphalt paving take place on the City's road surfaces from May 1st to October 1st; and/or during optimal climatic conditions that are conducive to the best mix compacting and long term durability of the pavement, according to the highest and best practices of the asphalt paving industry.
   (Ord. 270-2014. Passed 12-29-14.)

2. **Chapter 105.03 – U.S. Steel Usage Required; Exception.**
   All City contracts shall stipulate or provide that all steel necessary in the construction of any work performed under such contracts shall be steel that is produced in the United States unless a specific product which is required is not produced by manufacturers in the United States in which event this prohibition does not apply. This section shall apply to only contracts awarded by the Board of Control of the City.
   (Ord. 224-77. Passed 6-27-77.)

3. **Chapter 105.05 – Materials to be Purchased Locally.**
   In all future contracts for the construction of buildings, structures, or other improvements under the Capital Improvement Budget, the following clause shall be printed or typewritten on each contract:
   It is the desire of the City of Canton that all materials used in the construction covered by this contract shall be purchased in the Canton area except such materials which are unavailable in the Canton area.
   (Res. 49-77. Passed 2-7-77.)

4. **Chapter 105.06 – Minority Contract Provision.**
   a. All contracts with the City shall include the following clause:
   The bidder agrees to expend at least $_____of the Contract in the event the contract is awarded to such bidder for minority/women's business enterprises. For purposes of this pledge, the term "minority/women's business enterprise" means a bona fide business established as a sole proprietorship, partnership or corporation owned, operated and controlled by one or more minority persons or women who have at least fifty-one percent (51%) ownership. "Minority" includes African Americans, Asian/Pacific Islanders, Hispanic/Latino Americans and Native American Indians. The minority or woman must have operational and managerial control, interest in capital, and earnings commensurate with the percentage of ownership. Minority/women's business enterprises may be employed as construction contractors, subcontractors, vendors or suppliers.
   (Ord.185-2011. Passed 10-31-11.)

5. **Chapter 105.12 – Local Bidder Preference.**
   a. The Board of Control, in determining the lowest and best bidder in the award of contracts to which this section is applicable, is authorized to award contracts to local bidders as hereinafter defined, whose bid is not more than five percent (5%) higher, subject to a maximum amount of twenty thousand dollars ($20,000.00), than the lowest dollar bid submitted by non-local bidders. The Board of Control's decision in making such an award shall be final.

b. For purposes of this section, "local bidder" means an individual or business entity which at the time of the award of the contract has a headquarters, division, sales office, sales outlet, manufacturing facility, or similar significant business-related location in Stark County, Ohio.

c. All contract specifications and/or bid documents that are distributed by Canton for the purpose of soliciting bids for goods and/or services shall contain the following notice:

Prospective bidders will take notice that the City of Canton, in determining the lowest and best bidder in the award of this contract, may award a local bidder preference to any qualified bidder pursuant to Section 105.12 of the Codified Ordinances of the City of Canton. The determination of whether a bidder qualifies for the local preference shall be made by Board of Control. The Board's decision shall be final. A copy of Section 105.12 is attached.

d. This section shall be applicable to all contracts for equipment, goods, machinery, materials, supplies, vehicles and/or services, which are purchased, leased and/or constructed at a cost in excess of fifty thousand dollars ($50,000.00) and which require bidding pursuant to Ohio R.C. 735.05 through 735.09 and Ohio R.C. 737.03.

(Ord. 115-2018. Passed 5-14-18.)

6. Chapter 105.15 – City Income Tax

a. No person, partnership, corporation or unincorporated association may be awarded a contract with the City under Sections 105.09 or 105.10, unless the bidder is paid in full or is current and not otherwise delinquent in the payment of City income taxes, including any obligation to pay taxes withheld from employees under Section 182.05 and any payment on net profits under Section 182.06.

b. Falsification of any information related to or any post-contractual violation of the requirement to pay City income taxes set forth in subsection (a) shall constitute cause for the rescission of the balance of the contract at the City's discretion.

c. No partnership, corporation or unincorporated association which has as one of its partners, shareholders or owners a person who is a twenty percent (20%) or greater equity owner in such partnership, corporation or unincorporated association and who is delinquent in the payment of City income taxes as set forth in subsection (a), may be awarded a contract with the City under Sections 105.09 or 105.10.

d. A person who is a twenty percent (20%) or greater equity owner in any partnership, corporation or unincorporated association which is delinquent in the payment of City income taxes as set forth in subsection (a) may not be awarded a contract with the City under Sections 105.09 or 105.10.

e. A contract awarded under Sections 105.09 or 105.10 for a public improvement project, services other than personal or professional services, and personal or professional services shall not be binding or valid unless such contract contains the following provisions:

Said _____ hereby further agrees to withhold all City income taxes due or payable under Chapter 182 of the Codified Ordinances for wages, salaries, fees and commissions paid to its employees and further agrees that any of its subcontractors shall be required to agree to withhold any such City income taxes due for services performed under this contract. Furthermore, any person, firm or agency that has

a contract or agreement with the City shall be subject to City income tax whether a resident or nonresident in the City, and whether the work being done is in the City or out of the City. In addition to the tax withheld for employees, the net profits on the contract shall be subject to City income tax.
(Ord. 238-2015. Passed 11-30-15.)

7. Chapter 182.30 – Contract Provisions

a. No contract on behalf of the City under Sections 105.09 or 105.10 of the Codified Ordinances of Canton for a public improvement project, services other than personal or professional services, and personal or professional services shall be binding or valid unless such contract contains the following provisions:

Said _____ hereby further agrees to withhold all City income taxes due or payable under Chapter 182 of the Codified Ordinances for wages, salaries, fees and commissions paid to its employees and further agrees that any of its subcontractors shall be required to agree to withhold any such City income taxes due for services performed under this contract. Furthermore, any person, firm or agency that has a contract or agreement with the City shall be subject to City income tax whether a resident or nonresident in the City, and whether the work being done is in the City or out of the City. In addition to the tax withheld for employees, the net profits on the contract shall be subject to City income tax.

b. By entering into contract with the City of Canton _____ agrees with the City regarding the manner of withholding of City income taxes as provided in Section 718.011(F) of the Ohio Revised Code.
   i. Municipal income tax withholding provisions of Sections 718.011(B)(1) and 718.011(D) ORC shall not apply to qualifying wages paid to employees for work done or services performed or rendered inside the City or on City property.
   ii. _____ agrees to withhold income tax for the City from employees' qualifying wages earned inside the City or on City property, beginning with the first day of work done or services performed or rendered inside the City.

(Ord. 238-2015. Passed 11-30-15.)

8. Chapter 507.03 – Equal Employment Opportunity Clause.

b. During the performance of this contract, the contractor agrees as follows:
   1. The contractor shall not discriminate against any employee or applicant for employment because of race, age, handicap, religion, color, sex, national origin, sexual orientation or gender identity. The contractor shall take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to race, religion, color, sex, national origin, military status, sexual orientation or gender identity. As used herein, the word "treated" shall mean and include without limitation the following: recruited, whether by advertising or other means; compensation, whether in the form of rates or pay or other forms of compensation; selected for training, including apprenticeship; promoted; demoted; upgraded; downgraded; transferred; laid off; and terminated. The contractor agrees to and shall post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting officers setting forth the provisions of this nondiscrimination clause.
   2. The contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, age, handicap, religion, color, sex, national origin, military status, sexual orientation or gender identity.

(Ord. 153-2012. Passed 9-24-12.)

3. The contractor shall send to each labor union or representative of workers, with which he has a collective bargaining agreement or other contract or understanding, a notice advising the labor union or workers' representative of the contractor's commitments under the equal opportunity clause of the City; and he shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. The contractor shall submit in writing to the City his affirmative action plan, and each subcontractor and supplier of equipment or supplies shall submit to the general contractor his affirmative action plan. The responsibility for securing these affirmative action plans falls upon the general contractor and shall be on file at the office of the general contractor. The contractor shall furnish all information and reports required by the City or its representative pursuant to this chapter, and shall permit access to his books, records, and accounts by the contracting agency and by the Executive Secretary for purposes of investigation to ascertain compliance with the program.
5. The contractor shall take such action with respect to any subcontractor as the City may direct as a means of enforcing the provisions of this equal opportunity clause, including penalties and sanctions for noncompliance; provided, however, that in the event the contractor becomes involved in or is threatened with litigation as the result of such direction by the City, the City will enter into such litigation as is necessary to protect the interests of the City and to effectuate the City's equal opportunity program and, in the case of contracts receiving Federal assistance, the contractor or the City may request the United States to enter into such litigation to protect the interests of the United States.
6. The contractor shall file and shall cause his subcontractors, if any, to file compliance reports with the City in the form and to the extent prescribed by the City or its representative. Compliance reports filed at such times as directed shall contain information as to the employment practices, policies, programs and statistics of the contractor and his subcontractors.
7. The contractor shall include the provisions of this equal employment opportunity clause in every subcontract or purchase order, so that such provisions will be binding upon each subcontractor or vendor.
8. Refusal by the contractor or subcontractor to comply with any portion of this program as herein stated and described will subject the offending party to any or all of the following penalties:
    A. Withholding of all future payments under the involved public contract to the contractor in violation, until it is determined that the contractor or subcontractor is in compliance with the provisions of this contract.
    B. Refusal of all future bids for any public contract with the City or any of its departments or divisions, until such time as the contractor of subcontractor demonstrates that he has established and shall carry out the policies of the program as herein outlined.
    C. Cancellation of the public contract and declaration of forfeiture of the performance bond.
    D. In cases in which there is substantial or material violation or the threat of substantial or material violation of the compliance procedure or as may be provided by contract, appropriate proceedings may be brought to enforce these provisions, including the enjoining within applicable laws of contractors, subcontractors or other organizations, individuals or groups who prevent, directly or indirectly, or seek to prevent, directly or indirectly, compliance with the policy as herein outlined.

(Ord. 179-74. Passed 6-17-74.)

The City of Canton

STATEMENT OF CLAIM FORM

Claim No. ___ for Contractor

1. Name of Contractor: _____

2. Date written claim given:_____.

3. Contractor's representative to contact regarding the claim:

   Name:_____ Title: _____
   Telephone No. _____ (office) FAX No. _____

   E-mail: _____

4. General description of claim:

---

5. Contract Documents. If the claim is based upon any part or provision in the Contract Documents, including but not limited to pages in the Drawings and/or paragraphs in the Specifications, Owner-Contractor Agreement, General Conditions or Supplementary General Conditions, state upon which parts or provisions the claim is based:

---

6. Delay claims:

   6.1 Date delay commenced: _____
   6.2 Duration of the delay: _____
   6.3 Apparent cause of the delay and part of critical path affected:

   6.4 Impact of the delay and recommendations for minimizing such impact:

---

7. Additional compensation. Set forth in detail all additional compensation to which the Contractor believes it is entitled with respect to this claim:

---

8. Instructions for Completing the Statement of Claim Form ("Instructions"). The Instructions are incorporated in this Form.

9. Truth of Claim. By submitting this claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has complied fully with the Instructions, b) the information in this State of Claim is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

CONTRACTOR: _____

By: _____

Name and Title: _____

Date: _____

CONTRACTOR'S ACKNOWLEDGMENT

State of _____,

County of _____, ss:

_____ first being sworn, states that after conscientious and thorough review, the statements made in attached Statement of Claim Form are complete and true to the best of his or her knowledge and belief.

_____

Sworn to before me a notary public by _____ on _____ __, 20__.

_____

Notary Public

WHEN COMPLETED, FORWARD A COPY OF THIS NOTICE AND STATEMENT OF CLAIM FORM TO THE OWNER AND ENGINEER.

INSTRUCTIONS FOR COMPLETING THE STATEMENT OF CLAIM FORM

1. Completing the Statement of Claim Form ("Claim Form") is a material term of the Contract. The Claim Form tells the Owner and Design Professional that the Contractor is making a Claim and that they need to act promptly to mitigate the effects of the occurrence giving rise to the Claim. The Claim Form also provides them with information so that they can mitigate such effects. The Contractor acknowledges that constructive knowledge of the conditions giving rise to the Claim through job meetings, correspondence, site observations, etc. is inadequate notice, because knowledge of these conditions does not tell the Owner and Engineer that the Contractor will be making a Claim and most often is incomplete.

2. If the space provided in the Claim Form is insufficient, the Contractor, as necessary to provide complete and detailed information, must attach pages to the Claim Form with the required information.

3. Paragraph 4. The Contractor must state what it wants, *i.e.*, time and/or compensation, and the reason why it is entitled to time and/or compensation.

4. Paragraph 5. The Contractor must identify the exact provisions of the Contract Documents it is relying on in making its Claim. For example, if the Claim is for a change in the scope of the Contractor's Work, the Contractor must identify the specific provisions of the Specifications, and the Plan sheets and details that provide the basis for the scope change.

5. Paragraph 6. This paragraph applies to delay claims, including delays that the Contractor believes result in constructive acceleration. The Contractor must identify the cause of the delay, party or parties responsible, and what the party did or did not do that caused the delay, *i.e.*, specific work activities. The Contractor acknowledges that general statements are not sufficient, and do not provide the Owner with sufficient information to exercise the remedies available to the Owner or to mitigate the effects of the delay.

   For example, if the Contractor claims a slow response time on submittals caused a delay, the Contractor must identify the specific submittals, all relevant dates, and then show on the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Also for example, if the Contractor claims it was delayed by another Contractor, the Contractor must identify the delaying Contractor, specifically what the delaying Contractor did or did not do that caused the delay, and then show the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Further by example, if the Contractor seeks an extension of time for unusually severe weather, the Contractor must submit comparative weather data along with a record of the actual weather at the job site and job site conditions.

6. Paragraph 6.4. Time is of the essence under the Contract Documents. If there is a delay, it is important to know what can be done to minimize the impact of the delay. It therefore is important that the Contractor provide specific recommendations on how to do so.

7. Paragraph 7. The Contractor must provide a specific and detailed breakdown of the additional compensation it seeks to recover. For future compensation, the Contractor shall provide its best estimate of such compensation.

8. Paragraph 8 and Acknowledgment. By submitting this Claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has complied fully with the Instructions, b) the information in this Claim Form is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the

Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

End of Instructions

The City of Canton

CONTRACTOR'S PERSONAL PROPERTY TAX AFFIDAVIT

(O.R.C. § 5719.042)

State of Ohio
County of _____, ss:

_____, being first duly sworn, deposes and says that he is the
(Name)

_____ of _____ with offices located at
(Title) (Contractor)

_____, and as its duly
(Address of Contractor)

authorized representative, states that effective this _____ day of _____, 20___,

_____
(Name of Contractor)

( ) is charged with delinquent personal property taxes on the general list of personal property as set forth below:

County	Amount (includes total amount due, plus penalties and interest thereon)
Stark	$_____

( ) is not charged with delinquent personal property taxes on the general list of personal property in Stark County.

_____

_____
(Affiant)

Sworn to and subscribed before me by the above-named affiant this _____ day of _____, 20__.

_____
(Notary Public)

My commission expires

_____, 20__

The City of Canton

CONTRACTOR'S FINAL WAIVER & RELEASE AFFIDAVIT
("AFFIDAVIT")

Project: **Sugar Creek Water Treatment Plant & Wellfield Improvements**

In consideration for payment received from the City of Canton (the "City") in the amount requested in Contractor's Final Application for Payment to the City, the receipt of which is hereby acknowledged, the undersigned Contractor hereby waives and releases any rights it has or may have to any and all types of claims relating to the Project, including without limitation claims of payment, Mechanic's Lien, stop notice, equitable lien, labor and material bond, breach of contract or unjust enrichment, or any other claim against the City, for any labor, materials, or equipment the undersigned may have delivered or provided to the Project, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned further certifies that this Affidavit covers claims by all contractors, subcontractors, and suppliers who may have provided any labor, material, or equipment to the Project through the undersigned or at the undersigned's request. The undersigned acknowledges that all such contractors, subcontractors, sub-subcontractors and suppliers have signed an affidavit in the form of this Affidavit releasing any and all claims against the City, except for any Claims the undersigned has made by properly and timely submitting a written statement of its Claim. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

This Affidavit is for the benefit of, and may be relied upon by the City. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, work of improvement, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit.

_____
Company Name

_____
Authorized Signature (Company Officer)

_____
Title

_____
Date

State of: _____ County of _____

Subscribed and sworn to before me this _____

day of _____

Notary Public: _____

My Commission Expires: _____

CITY OF CANTON

Sugar Creek Water Treatment Plant & Wellfield Improvements Project

PRE-BID SUBSTITUTION FORM

1. Note. Certain brands of material or apparatus are specified. Each bid will be based on these brands, which may be referred to in the Contract Documents as Standards. The use of another brand (referred to as a substitution or proposed equal in the Contract Documents, when a bidder or the contractor seeks to have a different brand of material or apparatus than that specified approved by the Owner for use in the Project) may be requested as provided in the Instructions to Bidders. Substitutions, however, unless approved and issued in an Addendum, will not be considered in determining which bidder to award the contract to.

2. The detailed procedures for submitting substitutions are set forth in Paragraph K of the Instructions to Bidders.

Specification Section	Brand or Name Specified	Proposed Substitution

Appendix A

PROJECT LABOR AGREEMENT

FOR THE

SUGAR CREEK WATER TREATMENT PLANT & WELLFIELD IMPROVEMENTS PROJECT

ENTERED INTO BETWEEN

CITY OF CANTON

AND

EAST CENTRAL OHIO BUILDING AND CONSTRUCTION TRADES COUNCIL AFL-CIO

AND

SIGNATORY LOCAL UNIONS

Effective _____

CONTENTS

ARTICLE I

INTENT AND DURATION

Section 1. Intent And Duration. This Project Labor Agreement (the "Agreement" or "PLA") is entered into between the City of Canton (collectively the "Owner"); the East Central Ohio Building and Construction Trades Council, AFL-CIO ("ECOB & CTC" or "Council"); and the Signatory Unions (the "Unions"), and applies exclusively to the construction work within the scope of this Agreement to be performed on the Sugar Creek Water Treatment Plant and Wellfield Improvements Project (the "Project"). The purpose of this Agreement is to promote efficiency and cost-savings in the construction and refurbishment that is a part of the Project and to provide for the peaceful settlement of any and all labor disputes and grievances without strikes or lockouts, thereby promoting the public interest in assuring the timely and economical completion of the Project. This Agreement shall expire and be of no further force or effect upon the completion of the Project.

Upon execution of this Agreement by all parties, all construction, remodeling and renovation work covered by this Agreement on the Project shall be contracted exclusively to Contractors, of whatever tier, who agree to execute and be bound by the terms of this Agreement. The Unions agree that Contractors may execute the Agreement, or the Letter of Assent attached as Appendix I, for purposes of performing such work. The Owner (or its permitted designee) shall monitor compliance with this Agreement by all contractors and subcontractors. For purposes of the Agreement, the term "Contractor" shall be deemed to include all construction contractors and subcontractors of whatever tier engaged in on-site construction and renovation work on the Project. The Owner, the Unions and all signatory Contractors agree to abide by the terms and conditions contained in the Agreement. This Agreement represents the complete understanding of all parties, and no Contractor is or will be required to sign any other agreement with a signatory union as a condition of performing work coming within the scope of this Agreement. No practice, understanding or agreement between a Contractor and a Union, which conflicts with any provisions in this Agreement, will be binding on any other party unless endorsed in writing by the Owner.

Section 2. Limitation Of Agreement To Project. The Unions agree that this Agreement will be made available to, and will fully apply to, any successful bidder for

work on the Project, without regard to whether that successful bidder performs work at other sites on either a union or a non-union basis, and without regard to whether employees of such bidder are or are not members of any union. The Unions further agree that this Agreement applies only to this Project. Nothing in this agreement is intended to, or shall, interfere with, or negate, any existing contractual relationship or collective bargaining agreement between the Union and any contractor or subcontractor that may execute this Agreement.

ARTICLE II

PURPOSE

Section 1. Purpose. The Project Cost is fairly estimated to be $30.6 million dollars. The Project will require the construction of a new service and treatment building at the site of each of the existing ten (10) wells in the Wellfield. Also, approximately 3,900 linear feet of new 36" raw water transmission pipeline will be installed in the Wellfield and must be interconnected with the existing transmission lines. In addition, the existing water treatment plant and equipment will be upgraded and renovated. This renovation and upgrade work will be done to existing aerators, filters, filter backwash systems, high service pumps, clear wells, all mechanical systems within the facility and all electrical and chemical feed systems within the facility. This is a major construction project that must be bid in early 2022 and commenced in the Spring of 2022. This Agreement covering this Project is necessary to secure and preserve the health and safety of Canton and Stark County residents and to protect the integrity of the City's water treatment and distribution system. The parties to this Agreement understand and acknowledge that the Project is critical to the economic development of the City of Canton and to advancing the goals appearing in the City's Comprehensive Plan.

Section 2. Time Is Of The Essence. The parties to this Agreement understand and agree that time is of the essence for this Project. The parties understand and agree that timely completion of the Project will require the use of substantial numbers of employees from construction and supporting crafts possessing skills and qualifications that are essential to the Project. The Unions pledge that they have members who are competent, skilled, and qualified to perform the required construction work. The parties also understand that on-budget completion of the

Project is most critical; it is therefore essential that construction work on the Project be done in an efficient, economical manner with optimum productivity and with no delays. In recognition of those special needs of the Project, the Unions signatory hereto and their members agree not to initiate, authorize, sanction, participate in or condone, or permit their members to engage in any strike, sympathy strike, jurisdictional strike, recognitional strike, slowdown, sabotage, work to rule, sickout, sit down, picketing of any type (including informational picketing), handbilling, boycott, interruption of work or any disruptive activity that interferes with or interrupts in any way work on the Project or other operations of the City of Canton or its Water Department. Contractors agree not to engage in any lockouts.

ARTICLE III

BENEFITS OF THE AGREEMENT

Section 1. Benefits Of The Agreement. This Agreement is intended to foster the achievement of a timely and on-budget completion of the Project by, among other things:

(a) reducing and/or eliminating the tension and potential disagreements that might otherwise exist between Union and non-union workers on the Project;

(b) avoiding the costly delays of strikes, sympathy strikes, jurisdictional strikes, slowdowns, walkouts, picketing, handbilling and any other disruptions or interference with work, and promoting labor harmony and peace for the duration of the Project;

(c) standardizing terms and conditions governing the employment of labor on the Project;

(d) permitting flexibility in work scheduling and shift hours and times;

(e) achieving negotiated adjustments as to work rules and staffing requirements from those which otherwise might obtain;

(f) providing comprehensive and standardized mechanisms for the settlement of work disputes;

(g) ensuring a reliable source of skilled and experienced labor; and

(h) furthering public policy objectives, to the extent lawful, as to improved employment opportunities for minorities, women and the economically disadvantaged in the construction industry. Mindful of the economic

condition and unemployment rate in Stark County, the Owner anticipates and expects that all construction workers and employees on this Project will be residents of Stark County. In view of the very technical and specialized work that is inherent in the construction industry, all parties acknowledge that this expectation by the Owner is a goal, not a mandate. To this end, all Contractors working under this Agreement pledge that they will make a good-faith effort to reach this goal expressed by the Owner.

ARTICLE IV

SCOPE OF AGREEMENT

Section 1. The Work. This Agreement is specifically defined and limited to onsite construction and renovation work required to construct the Project.

Section 2. Exclusions From Scope. Items specifically excluded from the scope of this Agreement, even if performed in connection with the Project, include the following:

(a) Work of non-manual employees, including but not limited to, superintendents, supervisors, staff engineers, inspectors, quality control and quality assurance personnel, timekeepers, mail carriers, clerks, office workers, including messengers, guards, safety personnel, emergency medical and first aid technicians, and other professional, engineering, administrative, supervisory and management employees.

(b) Equipment and machinery owned or controlled and operated by the Owner.

(c) All off-site manufacture, fabrication or handling of materials, equipment or machinery (except at dedicated lay-down or storage areas and except as provided in Article IV, Section 9), and all deliveries of any type to and from the Project site (except on-site pouring of concrete).

(d) All employees of the Owner, the Construction Supervisor, design team or any environmental, engineering or other consultant when such employees do not perform labor coming within the scope of this Agreement.

(e) Any work performed on or near or leading to or onto the site of work on the Project and undertaken by state, county, city or other governmental

bodies, or their contractors; or by public utilities or their contractors.

(f) Off-site maintenance of leased equipment and on-site supervision of all such maintenance work.

(g) Work by employees of a manufacturer or vendor necessary to maintain such manufacturer's or vendor's warranty or guarantee, or work performed by supervisors or technicians employed by the manufacturer or vendor to oversee the testing of equipment once installed to insure that the equipment is fully operational.

(h) Laboratory work for specialty testing or inspections not ordinarily done by the signatory local unions.

(i) All work done by employees of any State agency, authority or entity or employees of any municipality or other public employer.

(j) This Agreement does not apply to work covered under a collective bargaining agreement between a contractor and a local union in the outside line branch of the International Brotherhood of Electrical Workers, including, but not limited to, construction of electrical transmission and distribution lines (including above-ground and below-ground lines), catenary and trolley facilities, switch yards, and substations.

The Unions agree that there shall be no interference with or disruption of work, of those contractors, employers, and employees exempted from coverage of this Agreement by subparagraph (a) through (i) above.

Section 3. Contract Award and Consent to Agreement.

(a) The Owner, and/or Contractors, as appropriate, have the absolute right to award contracts or subcontracts on the Project notwithstanding the existence or nonexistence of any agreements between such Contractor and any Union party provided only that such Contractor is willing, ready and able to execute and comply with this Agreement or a Letter of Assent thereto, should such Contractor be awarded work covered by this Agreement.

(b) All subcontractors of a Contractor, of whatever tier, who have been awarded contracts of work covered by this Agreement, on or after the

effective date of this Agreement, shall also be required to accept and to be bound by the terms and conditions of this Agreement, and shall evidence their acceptance by the execution of this Agreement or a Letter of Assent thereto, prior to the commencement of work. A copy of this Agreement or Letter of Assent executed by each Contractor shall be immediately provided to the Union upon execution.

Section 4. Stand-Alone Agreement. This Agreement is a stand-alone Agreement. While this Agreement expressly does not incorporate any local area collective bargaining agreements, such local area collective bargaining agreements may be referenced for the limited purposes as hereinafter set forth in this Agreement. However, to the extent, if any, that any provisions of this Agreement conflict with any provision of a local area collective bargaining agreement, the provisions of this Agreement shall control, except for all work performed under the NTL Articles of Agreement, the National Stack/Chimney Agreement, the National Cooling Tower Agreement, all instrument calibration work and loop checking shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors, with the exception of Articles VII, VIII and X of this Agreement, which shall apply to such work.

Section 5. Craft Jurisdiction. This Agreement shall recognize the traditional craft jurisdictions of the signatory unions. Any and all jurisdictional disputes shall be settled in accordance with Article VIII below. While this Agreement is a stand-alone Agreement, the Agreement will utilize the local area collective bargaining agreements of signatory locals, not state-wide agreements or other special project agreements, as a reference to define the signatory local unions' craft jurisdiction.

Section 6. Subcontracting. The Owner agrees that neither it nor any of its contractors or subcontractors will subcontract any work covered by this Agreement to be done on the Project except to a person, firm or corporation who is or agrees to become party to this Agreement. Any contractor or subcontractor working on the Project shall, as a condition to working on said Project, become signatory to and perform all work under the terms of this Agreement. Contractors who are signatory to local are collective bargaining agreements shall be bound by the terms of their

respective local collective bargaining agreements on subcontracting to the extent such terms are consistent with Article IV, Section 2 of this Agreement. Disputes concerning compliance with such local subcontracting provisions for this Project shall be subject to all of the dispute resolution provisions of this Agreement.

Section 7. Liability. It is understood that the liability of the Contractor and the liability of the separate Unions under this Agreement shall be several and not joint. The Unions agree that this Agreement does not have the effect of creating any joint employer status between or among the Owner, Construction Supervisor and/or any Contractor, and neither the Owner nor Construction Supervisor shall assume any liabilities of the Contractors.

Section 8. Abatement of Agreement. As areas of covered work on the Project are accepted by the Owner, this Agreement shall have no further force or effect on such areas except where the Contractor is directed by the Owner to engage in repairs or punch list modifications.

Section 9. Miscellaneous. Notwithstanding any other provision of this Agreement, this Agreement applies and is limited to the recognized and accepted historical definition of demolition and new construction work under the direction of and performed by the contractor(s), of whatever tier, who have contracts awarded for such work on the project. Such work shall include site preparation work and dedicated off-site work except for the contractors and subcontractors specifically excluded in this Article II. Any off-site prefabrication of any building materials, systems and/or components traditionally performed on site shall be performed by the appropriate craft signatory to this Agreement and approved by the owner.

ARTICLE V

LABOR/MANAGEMENT COOPERATION

JOINT ADMINISTRATIVE COMMITTEE

Section 1. The parties to this Agreement shall establish a Project Joint Administrative Committee ("Committee"). This Committee will be a two-person committee comprised of one member each appointed by the Owner (or its designee) and the Unions, with an alternate appointee Union member available to replace the regular appointee when a problem or grievance concerns the regular appointee's Union. Each member of the Committee shall designate an alternate who shall serve in the absence of

the member for any purpose contemplated by this Agreement.

Section 2. The Committee shall meet at least quarterly, or more often if special circumstances warrant, to discuss the administration of the Agreement, the progress of the Project, labor/management problems that may arise, and any other relevant matters. Any need for interpretation which might arise from the application of the terms and conditions of the Agreement shall be referred directly to the Committee for resolution.

ARTICLE VI

UNION RECOGNITION AND EMPLOYMENT

Section 1. Pre-Hire Recognition. Each Contractor and subcontractor recognizes the Unions as the sole and exclusive bargaining representatives of all craft and trade employees within their respective jurisdictions working on the Project under the Agreement.

Section 2. Contractor's Right of Selection. Each Contractor shall have the right to determine the competency of all employees, the number of employees required and shall have the sole responsibility for selecting employees to be laid off. To the extent any training or vendor education is required to fill any position, said training shall be undertaken at no cost or expense to Owner.

Section 3. Union Referral. For local Unions having a job referral system, each Contractor agrees to comply with such system, and the referral system shall be used exclusively by such Contractor, except as modified by this Article. Such job referral system will be operated in a non-discriminatory manner and in full compliance with Federal, state, and local laws and regulations requiring equal employment opportunities and nondiscrimination, and referrals shall not be affected in any way by the rules, regulations, bylaws, constitutional provisions or any other aspects or obligations of union membership, policies or requirements. The Union shall indemnify and hold each Contractor harmless with respect to any claim arising out of how the Union operates and administers its referral system. All hiring procedures, including related practices affecting apprenticeship and training, will be operated so as to facilitate the ability of the contractors to meet any and all equal employment opportunity/affirmative action obligations. The Contractor may reject any referral and request another, different referral; provided, however, the Contractor shall furnish,

upon request from the Union, a written explanation for the rejection.

Section 4. Lack of Job Referral System. In the event that a signatory Local Union does not have a job referral system as set forth in Section 3 above, the Contractor shall give the Union a forty-eight (48) hour opportunity to refer applicants. The Contractor shall notify the Union of employees hired from any source other than referral by the Union.

Section 5. Unavailability of Union Referrals. In the event that local Unions are unable to fill any requisitions for qualified employees within forty-eight hours (48) after such requisition is made by the Contractor (Saturdays, Sundays, and Holidays excepted), the Contractor may employ applicants from any other available source. The Contractor shall inform the Union of the name, address and telephone number of any applicants hired from other sources and refer the applicant for the Local Union for dispatch to the Project.

Section 6. Union Best Efforts. The Local Unions will exert their utmost efforts to recruit sufficient numbers of skilled craft workers to fulfill the manpower requirements of each Contractor, including calls to local unions in other geographic areas when its referral lists have been exhausted. The parties to this Agreement support the development of increased numbers of skilled construction workers from the residents of the area of the Project. Toward that end, the Unions agree to encourage the referral and utilization, to the extent permitted by law and the hiring hall procedures, of qualified residents as journeymen, apprentices and trainees on the Project.

ARTICLE VII

GRIEVANCE ARBITRATION PROCEDURE

Section 1. This Agreement is intended to provide close cooperation between management and labor. Each of the Unions will assign a representative to this Project for the purpose of completing the construction of the Project economically, efficiently, continuously, and without interruptions, delays, or work stoppages.

Section 2. The Contractors, Unions, and the employees, collectively and individually, realize the importance to all parties to maintain continuous and uninterrupted performance of the work of the Project, and agree to resolve disputes in accordance with the grievance-arbitration provisions set forth in this Article.

Section 3. Any question or dispute arising out of and during the term of this

Agreement (other than trade jurisdictional disputes) shall be considered a grievance and subject to resolution under the following procedures:

Step 1. (a) When any employee subject to the provisions of this Agreement feels he or she is aggrieved by a violation of this Agreement, he or she, through his or her local union business representative or job steward, shall, within five (5) working days after the occurrence of the violation, give notice to the work-site representative of the involved Contractor stating the provision(s) alleged to have been violated. The business representative of the local union or the job steward and the work-site representative of the involved Contractor shall meet and endeavor to adjust the matter within three (3) working days after timely notice has been given. The representative of the Contractor shall keep the meeting minutes and shall respond to the Union representative in writing at the conclusion of the meeting but not later than twenty-four (24) hours thereafter. If they fail to resolve the matter within the prescribed period, the Local Union may, within forty-eight (48) hours thereafter, pursue Step 2 of the Grievance Procedure, provided the grievance is reduced to writing, setting forth the relevant information concerning the alleged grievance, including a short description hereof, the date on which the grievance occurred, and the provisions of the Agreement alleged to have been violated.

(a) Should the Local Union(s) or the Project Contractor or any Contractor have a dispute with the other party and if, after conferring, a settlement is not reached within three (3) working days, the dispute may be reduced to writing and proceed to Step 2 in the same manner as outlined herein for the adjustment of an employee complaint.

Step 2. The International Union Representative and the involved Contractor shall meet within seven (7) working days of the referral of a dispute to this second step to arrive at a

satisfactory settlement thereof. Meeting minutes shall be kept by the Contractor. If the parties fail to reach an agreement, the dispute may be appealed by the Union, in writing, in accordance with the provisions of Step 3.

Step 3. (a) If the grievance has been submitted but not adjusted under Step 2, either party may request in writing, within seven (7) calendar days thereafter, that the grievance be submitted to an Arbitrator mutually agreed upon by them. The Contractor and the involved Union shall attempt mutually to select an arbitrator, but if they are unable to do so, they shall request the Federal Mediation and Conciliation Services (FMCS) to provide them with a list of arbitrators from which the Arbitrator shall be selected. The rules of FMCS shall govern the conduct of the arbitration hearing. The decision of the Arbitrator shall be final and binding on all parties. The fee and expenses of such Arbitration shall be borne equally be the Contractor and the involved Local Union(s).

Section 4. Failure of the grieving party to adhere to the time limits established herein shall render the grievance null and void. Failure of the Contractor to adhere to the time limits established herein shall result in the grievance being sustained. The time limits established herein may be extended only by written consent of the parties involved at the particular step where the extension is agreed upon. The Arbitrator shall have the authority to make decisions only on issues presented to him or her, and he or she shall not have authority to change, amend, add to or detract from any of the provisions of this Agreement.

Section 5. The Owner shall be notified of all actions at Steps 2 and 3 and shall, upon their request, be permitted to participate in all proceedings at these steps.

ARTICLE VIII

JURISDICTIONAL DISPUTES

Section 1. The assignment of work will be the responsibility of the Contractor performing the work involved and such work assignments will be in accordance with decisions issued under the Plan for the Settlement of Jurisdictional Disputes in the

Construction Industry (the "Plan"), or any successor Plan, adopted by the National Building and Construction Trades Department.

Section 2. All jurisdictional disputes on this Project, between or among Building and Construction Trades Unions and employers, parties to this Agreement, shall be settled and adjusted according to the present Plan established by the Building and Construction Trades Department or any other plan or method of procedure that may be adopted in the future by the Building and Construction Trades Department. Decisions rendered shall be final, binding and conclusive on the Contractors and Unions parties to this Agreement.

Section 3. All jurisdictional disputes shall be resolved without the occurrence of any strike, work stoppage, or slow-down of any nature, and the Contractor's assignment shall be adhered to until the dispute is resolved. Individuals violating this section shall be subject to immediate discharge.

Section 4. Each Contractor will conduct a pre-job conference with the appropriate Council prior to commencing work. The Owner will be advised in advance of all such conferences and may participate if they wish.

ARTICLE IX
MANAGEMENT'S RIGHTS

Section 1. Exclusive Owner - Workforce. Except as otherwise provided in this Agreement, the Owner (or its designee) and the Contractors retain the authority to manage their operations and workforces.

Section 2. Materials, Design, Machinery, Equipment. There shall be no limitation or restriction by a signatory Union upon a Contractor's choice of materials or design, nor, regardless of source or location, upon the full use and utilization of equipment, machinery packaging, pre-cast, pre-fabricated, pre-finish, or pre-assembled materials, tools or other labor saving devices. The on-site installation or application of all items shall be performed by the craft having jurisdiction of such work; provided, however, that installation of specialty items may be performed by employees employed under this Agreement who may be directed by other personnel in a supervisory role, in circumstances requiring special knowledge of the particular items.

Section 3. New Technology, Equipment. The use of new technology, equipment, machinery, tools and/or labor saving devices and methods of performing

work may be initiated by any Contractor from time to time during the Project. The Union agrees that it will not in any way restrict the implementation of such new devices or work methods.

Section 4. Disputes. If there is any disagreement between any Contractor and the Union concerning the manner or implementation of such device or method of work, the implementation shall proceed as directed by the Contractor, and the Union shall have the right to grieve and/or arbitrate the dispute as set forth in Article VII of this Agreement.

ARTICLE X

WORK STOPPAGES

Section 1. No Strikes or Work Disruptions. There shall be no strike, sympathy strike, jurisdictional strike, recognitional strike, slowdown, sabotage, work to rule, sickout, sit down, picketing of any type (including informational picketing), handbilling, boycott, interruption of work or any disruptive activity that interferes with or interrupts in any way work on the Project. The applicable local union shall not sanction, aid or abet, encourage or continue any work stoppage, strike, picketing or other disruptive activity which violates this Article and shall undertake all reasonable means to prevent or to terminate any such activity. No employee shall engage in activity which violates this Article. Any employee who participates in or encourages any activity which violates this Article shall be subject to disciplinary action, including discharge, and if justifiably discharged for the above reasons, shall not be eligible for rehire on the same project for a period of not less than ninety (90) days. Further, if the Local Union is unable to provide qualified replacements for those employees who are in violation of this Article by the beginning of the next shift, the Employer is free to hire from any source.

Section 2. Union Responsibilities. The Local Union shall not be liable for acts of employees for which it has no responsibility. The principal officers of the Local Union will immediately instruct, order and use their best efforts to cause the members of the Local Union they represent to cease any violations of this Article. If it complies with this obligation, the Local Union shall not be responsible for unauthorized acts of employees it represents.

ARTICLE XI

WAGES AND BENEFITS

Section 1. Wages. All employees covered by this Agreement shall be classified in accordance with work performed and paid 100% of the wages and 100% of the fringe benefits as established in the respective Union's Local Area Collective Bargaining Agreement and any subsequent modifications thereto. The Contractor, upon request, shall provide the Unions and Owner with substantiation that wages and benefits are being paid on the Project. The Unions shall provide the Owner, and any Contractor or subcontractor that is party to this Agreement, with wage, fringe benefit and dues reporting forms.

Section 2. Payment of Benefits/Contributions. Each Contractor will also pay all required contributions in the amounts required by Section 1 of this Article to the established employee benefit funds that accrue to the direct benefit of the employees (such as pension and annuity, health and welfare, vacation, apprenticeship, training funds). With respect to contributions required in this Section to Employer-Union jointly trusted funds, the Contractor adopts and agrees to be bound by the written terms of the legally established trust agreement specifying the detailed basis on which payments are to be made into, and benefits paid out of, such Trust Funds. The Contractor authorizes the parties to such Trust Funds to appoint Trustees and successor Trustees to administer the Trust Funds and hereby ratifies and accepts the Trustees so appointed as if made by Contractor.

Section 3. Non-Affiliated Labor Organizations. The Contractor shall deduct from each employee's wages all uniform dues and working assessments the employee has voluntarily authorized in writing as set forth in the Employee's Local Collective Bargaining Agreement. If a labor organization is not affiliated with the Council, and supplies its members or referrals for work on the Project, such labor organization shall pay to the Council the dues and assessments it would owe the Council if affiliated, for all periods during which the labor organization has members or referrals working on the Project. Any disputes under this paragraph shall be resolved exclusively between the labor organization and the Council by using the grievance procedure appearing in Article VII, as provided herein. All grievances shall be reduced to writing within thirty (30) days of the date on which the aggrieved party

discovered the dispute. The grievance shall be initiated at Article VII, Section 3, Step 3.

ARTICLE XII
LOCAL UNION NEGOTIATIONS DURING
THE PENDENCY OF THE AGREEMENT

Section 1. All parties to this Agreement understand and acknowledge that some crafts who will be working on the Project are covered by local collective bargaining agreements that will expire prior to the projected completion of the Project. All parties understand and agree that irrespective of whether such local collective bargaining agreement negotiations are successful or unsuccessful, there shall be no strike, sympathy strike, jurisdictional strike, recognitional strike, slowdown, sabotage, work to rule, sickout, sit down, picketing of any type (including informational picketing), handbilling, boycott, interruption of work or any disruptive activity that interferes with or interrupts in any way work on the Project by any Union involved in such local negotiations, or by any of its members, nor shall there be any lockout by a Contractor on the Project affecting such union or its members during the course of such negotiations. Irrespective of the status of any such local collective bargaining agreement negotiations, the affected Union and all of its members will observe and fully comply with the provisions of this Agreement. Should any Local Union fail or refuse to provide and/or refer qualified employees for work on the Project during an economic strike, any affected Contractor shall be permitted to utilize the procedures appearing in Article VI, Section 5 of this Agreement.

Section 2. Wage/Benefit Increases. Should a craft covered by this Agreement negotiate an increase in wages or an increase in benefits with any Contractor to become effective during the term of the Project, those wage and/or benefit increases shall be paid by the affected Contractor, as of the effective date of those increases, to those employees in that craft performing work covered by this Agreement.

ARTICLE XIII
HOURS OF WORK, OVERTIME, SHIFTS AND HOLIDAY

Section 1. Work Day and Work Week. Except as provided in Section 4, the first shift shall consist of eight (8) or ten (10) hours per day between the hours of 6:00 a.m. and 5:30 p.m., plus one-half (1/2) hour unpaid for lunch, approximately mid-way

through the shift. Forty (40) hours per week shall constitute a regular week's work, whether consisting of five (5) eight (8) eight hours days, or four (4) ten (10) hour days. The work week will start on Monday and conclude on Sunday. A uniform starting time will be established for all crafts on each project or segment of the work. Nothing herein shall be construed as guaranteeing any employee eight (8) or ten (10) hours per day or forty (40) hours per week. The Union(s) shall be informed of the work starting time set by the contractor at the pre job conference which may be changed thereafter upon three (3) days' notice to the Union(s) and the employees. A second shift, if used, shall consist of eight hours between 3:00 p.m. and 1:00 a.m.; a third shift, if used, shall begin between 10:00 p.m. and 1:00 a.m. For purposes of Section 3, the third shift shall be considered as part of the prior day's work.

Section 2. Starting Times. Employees shall be at their place of work at the starting time and shall remain at their place of work (as designated by the Contractor) performing their assigned functions until quitting time, which is defined as the scheduled end of the shift. The parties reaffirm their policy of a fair day's work for a fair day's wage. There shall be no pay for time not worked unless the employee is otherwise engaged at the direction of the Contractor.

Section 3. Overtime. Overtime shall be defined as all hours worked in excess of forty (40) hours in a work week or, for 8 hour shifts, in excess of eight (8) hours per day; or for 10 (ten) hour shifts for work in excess of 10 hours per day; such work and work performed on Saturdays shall be paid at one and one-half times the straight time rate of pay. However, in scheduled four (4) day/ten hour shift work weeks, Friday may be scheduled as a "makeup" day at straight time to make up for a day lost (Monday through Thursday) due to inclement weather. In addition, if a "make-up" day is scheduled, all employees directed to work on such day will be guaranteed a minimum of four (4) hours work or pay. In any week in which employees on the Project are scheduled on four/ten hour shifts, an employee whose first day of work on the Project begins on Wednesday or later day of the schedule shall be paid, during the first week of his employment only, time-and-one-half for all hours worked in excess of eight in a day or each day he works during said week. Work on Sundays and holidays shall be at double time. There shall be no restriction on any contractor's scheduling of overtime or the non-discriminatory designation of employees who will work. The

contractor shall have the right to schedule work so as to minimize overtime. There shall be no pyramiding of overtime pay under any circumstances.

Section 4. Shifts.

(a) Shift work may be performed at the option of the Contractor(s) upon three (3) days' prior notice to the Union and shall continue for a period of not less than five (5) working days. Saturdays and Sundays, if worked, may be used for establishing the five (5) day minimum work shift. If two shifts are worked, each shall consist of eight (8) hours of continuous work exclusive of a one--half (½) hour non-paid lunch period. Any third shift shall consist of seven (7) hours of continuous work exclusive of one-half (½) hour non-paid lunch period for eight (8) hours pay. A premium of $.25 per hour shall be paid for work on the second shift and $.50 per hour for work on the third shift.

(b) The Contractor may establish a work week of four (4) consecutive ten (10) hour work days (exclusive of one-half (½) hour unpaid lunch, approximately midway through the shift) between Monday through Thursday.

Section 5. Minimum Pay. An employee who reports for work at the regular starting time and for whom no work is provided shall receive pay equivalent to two (2) hours at the applicable hourly rate, provided the employee at the employer's discretion remains available for work. Any employee who reports for work and for whom work is provided shall be paid for actual time worked but not less than two (2) hours. It will not be a violation of this agreement when the employer considers it necessary to shut down to avoid the possible loss of human life, because of an emergency situation that could endanger the life and safety of an employee. In such cases, employees will be compensated only for the actual time worked. In the case of a situation described above where the employer requests employees to remain available for work, the employees will be compensation for such time. If a project is shut down because of weather, employees, who report for work, shall be paid actual time worked but not less than two (2) hours. Procedures for prior notification of work cancellation shall be determined at the pre-job conference. The provisions of this section are not applicable where the employee voluntarily quits or lays off.

Section 6. Holidays. Holidays shall be New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the

Day after Thanksgiving Day, and Christmas Day. A holiday falling on Saturday shall be observed on the preceding Friday. A holiday falling on Sunday shall be observed on the following Monday.

Section 7. Meal Period. The Contractor will schedule a meal period of not more than one-half hour duration at the work location at approximately the mid-point of the scheduled work shift (4 hours in a five day work week, 5 hours in a four-day work week), consistent with Section 1; provided, however, that the Contractor may, for efficiency of the operation, establish a schedule which coordinates the meal periods of two or more crafts. If an employee is required to work through his meal period, he shall be compensated for the time worked at the applicable overtime rate and the employee shall, when work permits, eat his lunch "on the fly".

Section 8. No Organized Work Breaks. There will be one (1) break during the first four (4) hours of a shift which shall be taken at the employee's work station. Individual nonalcoholic beverage containers will be permitted at the employee's work station.

Section 9. Helmets to Hardhats.

(a) The Employers and the Unions recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in the building and construction industry. The Employers and Unions agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment (hereinafter "Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

(b) The Unions and Employers agree to coordinate with the Center to create and maintain an integrated database of veterans interested in working on this Project and of apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.

ARTICLE XIV

APPRENTICES

Section 1. Need For. The parties recognize the need to maintain continuing support of programs designed to develop adequate numbers of competent workers in the construction industry. The Contractor(s) will, accordingly, employ apprentices in their respective crafts to perform work on the Project in accordance with Section 2 below.

Section 2. Ratios. The Union agrees to cooperate with the Contractor in furnishing qualified apprentices as requested and if available. Apprentices shall perform the work of their craft in accordance with the ratios and terms in their local area collective bargaining agreements. To the extent requested by Owner, the Contractor(s) may use the maximum number of apprentices permitted by local collective bargaining agreements.

ARTICLE XV

DRUG AND ALCOHOL POLICY

Section 1. Drug and Alcohol Policy. All parties understand and agree that a drug and alcohol policy, approved by the Council, will be in force for all work performed under the Agreement. The drug and alcohol policy will prohibit the use, sale, transfer, purchase and/or possession of a controlled substance, alcohol and/or firearms while on the Project's premises and will require testing of employees. The drug and alcohol policy, attached hereto as Appendix 2, is incorporated into and made part of this Agreement and is implemented for all Contractors and employees working on the Project.

ARTICLE XVI

NON-DISCRIMINATION

Section 1. Policy. It is the continuing policy of the Owner, the Contractors and the Unions that the provisions of this Agreement shall be applied without discrimination because of age, race, sex, color, religion, creed, national origin, sexual orientation or any other basis prohibited by applicable law.

ARTICLE XVII

SOLE AND COMPLETE AGREEMENT

Section 1. The parties agree that this Agreement constitutes the sole and complete agreement between them governing the rates of pay and working conditions

of the construction employees working on the Project. This Agreement settles all demands and issues on the matters subject to collective bargaining and shall not be modified or supplemented in any way except by written agreement executed by the Owner and all parties.

ARTICLE XVIII

SEPARABILITY AND SAVINGS CLAUSE

Section 1. Intent of Parties. If any article or section of this Agreement shall be held invalid by law or by a tribunal of competent jurisdiction, or if compliance with or enforcement of any article should be restrained pending a final determination as to its validity, the remainder of this Agreement shall not be affected and shall remain in full force and effect. In the event that any article or section is held invalid, the parties hereto shall, upon the request of the Unions, enter into collective bargaining negotiations for the purpose of arriving at a mutually satisfactory replacement for such article during the period of invalidity or restraint. If the Owner and the Council cannot agree on a mutually satisfactory replacement, either party shall be permitted to submit its demand to formal interest arbitration under the Rules of Federal Mediation and Conciliation Service.

Section 2. Force of Agreement. The parties recognize the right of the Owner to withdraw, at its absolute discretion, the utilization of this Agreement as part of any bid specification should a court of competent jurisdiction issue any order which could result, temporarily or permanently, in a delay of the bidding, awarding, and/or construction work on the Project. Notwithstanding such an action by the Owner, or such court order, the parties agree that the Agreement shall remain in full force and effect on the Project, to the maximum extent legally possible. It is hereby agreed that this Agreement covers all of the signatory local unions listed below.

Section 3. Delegation. The Owner, in its sole and absolute discretion has the right to delegate its duties hereunder to a representative and/or designee who may be either an employee of Owner or a third party with whom Owner has contracted for contractor services.

OWNER
CITY OF CANTON

2-1-22

Director of Public Service

EAST CENTRAL OHIO BUILDING & CONSTRUCTION TRADES COUNCIL, AFL-CIO

Dave Kunz

PRESIDENT

APPROVED AS TO FORM

PDS

CITY OF CANTON
DIRECTOR OF LAW

BOILERMAKERS LOCAL NO. 744

By:_____

Name:_____

Title:_____

Date: _____

BRICKLAYERS LOCAL 6

By: Justin M. Gartrell

Name: Justin M. Gartrell

Title: Field Rep.

Date: 11-05-21

ELECTRICIANS LOCAL NO. 540

By:_____

Name:_____

Title:_____

Date: _____

OWNER
CITY OF CANTON

_____

_____

APPROVED AS TO FORM

_____
CITY OF CANTON
DIRECTOR OF LAW

EAST CENTRAL OHIO BUILDING & CONSTRUCTION TRADES COUNCIL, AFL-CIO

_____

_____

BOILERMAKERS LOCAL NO. 744

By: _____

Name: MARTIN D. MAHON

Title: BUSINESS MANAGER, SEC. TREAS.

Date: 12 · 1 · 2021

BRICKLAYERS LOCAL 6

By: _____

Name: _____

Title: _____

Date: _____

ELECTRICIANS LOCAL NO. 540

By: _____

Name: _____

Title: _____

Date: _____

OWNER
CITY OF CANTON

_____

_____

APPROVED AS TO FORM

_____
CITY OF CANTON
DIRECTOR OF LAW

EAST CENTRAL OHIO BUILDING & CONSTRUCTION TRADES COUNCIL, AFL-CIO

_____

_____

BOILERMAKERS LOCAL NO. 744

By:_____

Name:_____

Title:_____

Date: _____

BRICKLAYERS LOCAL 6

By:_____

Name:_____

Title:_____

Date: _____

ELECTRICIANS LOCAL NO. 540

By: _____

Name: Aaron M. Brown

Title: Business Manager / F.S.

Date: 12/2/2021

ELEVATOR CONSTRUCTORS
LOCAL NO. 45

By: _____

Name: Ron Johnston

Title: B.M.

Date: 11-3-2021

GENERAL TRUCK DRIVERS &
HELPERS UNION LOCAL NO. 92

By: _____

Name: Warren Brvstoski

Title: B.A.

Date: 10-29-21

GLAZIERS LOCAL NO. 1162

By: _____

Name: Scott Harter

Title: B.A.

Date: 11-3-21

HEAT & FROST INSULATORS AND ALLIED WORKERS LOCAL NO. 84

By: _____

Name: DAMON WIROBEL

Title: BUSINESS MANAGER

Date: 11/03/21

INDIANA/KENTUCKY/OHIO REGIONAL COUNCIL OF CARPENTERS

By: _____

Name: Kevin M Ennis II

Title: Senior Representative

Date: 10/27/21

IRONWORKERS LOCAL NO. 550

By: _____

Name: William V. Sherer II

Title: Business Manager

Date: 10-28-21

LABORERS LOCAL NO. 1015

By: _____

Name: Jake Croston Jr

Title: Business Manager

Date: 11/1/21

MILLWRIGHT PILEDRIVER LOCAL NO. 1090

By: _____

Name: Kevin M. Ennis Jr

Title: Senior Representative

Date: 10/27/21

OPERATIVE PLASTERERS' AND CEMENT MASONS LOCAL NO. 109

By: _____

Name: Bill Taggart

Title: Business Manager

Date: 10/26/2021

PAINTERS LOCAL NO. 603

By: _____

Name: Scott Harter

Title: B.A.

Date: 11-3-21

PLUMBERS, PIPEFITTERS AND REFRIGERATION LOCAL NO. 94

By: Dave Kirven

Name: DAVE KIRVEN

Title: BUSINESS MGR F.S.T

Date: 11/2/21

ROOFERS, LOCAL UNION NO. 88

By: Barbara A Dixon

Name: Barbara A. DIXON

Title: BUSINESS MANAGER

Date: Oct. 26, 2021

SHEET METAL WORKERS LOCAL NO. 33

By:

Name: JERRY DUGUEY

Title: BUSINESS AGENT

Date: 11-1-21

SPRINKLER FITTERS LOCAL NO. 669

By:_____

Name:_____

Title:_____

Date: _____

APPENDIX 1

LETTER OF ASSENT TO THE PROJECT LABOR AGREEMENT

FOR THE SUGAR CREEK WATER TREATMENT PLANT & WELLFIELD IMPROVEMENTS PROJECT

Pursuant to Article I, Section 1 of the Project Labor Agreement (the "Agreement") for the Sugar Creek Water Treatment Plant & Wellfield Improvements Project (the "Project"), the undersigned party hereby agrees that it will comply with and be bound by all of the terms and conditions of the Agreement and agrees to all approved amendments or revisions thereto.

This Letter of Assent shall ONLY apply to the above-referenced Project and shall remain in effect for the duration of the above-referenced Project, after which this understanding will automatically terminate without further notice.

For the Contractor (or Subcontractor of whatever tier):

Name of Contractor/Subcontractor: _____

Name and Signature of Authorized Person:

(Print Name) _____

(Title) _____

(Signature) _____

(Phone #) _____

(Date) _____

APPENDIX 2

EMPLOYEE DRUG AND ALCOHOL TESTING POLICY

SPECIFICATIONS

The Owner is committed to providing a safe workplace for the workers assigned the Project, promoting high standards of employment health, and fostering productivity that satisfies its quality expectations. Consistent with the intent and spirit of this commitment, the Owner and ECOB & CTC have established a substance abuse testing specification for the Project with the goal of maintaining a work environment that is free from the effects of the use of illegal drugs and alcohol. The Owner will implement the terms of this policy.

This specification is not intended as a substitute for the Contractors' complete written substance abuse policy. Normally, such policies include other important features, including, but not limited to, an employee education and awareness Program, a supervisor training program and an employee assistance program.

The policy for this Project requires that any construction employee entering the project site will comply with the substance abuse testing requirements as outlined in this section. The Owner reserves the right to amend this specification upon written notice to the Contractor and the Unions on the Project. The parties to this agreement shall recognize the Drug Free Work Site Program as implemented through participating Unions and/or Contractors as administered by the contractor, or for contractors who are not signatory to agreements with signatory unions belonging to ECOB & CTC, and their core employees, an equivalent program that meets the specifications, contractual requirements, and testing requirements as set forth in this Appendix 1.

CONTRACTUAL REQUIREMENTS

All Contractors must have and enforce a written Substance Abuse Program incorporating the testing requirements, term, and conditions set forth in this specification. This specification is applicable to all employees, current and prospective, in order to be eligible to perform work at the Project. The Contractors must comply with the specification. Supplies, vendors, and visitors are subject to confirmation of their abstinence from the possession or use of substances indicated in this specification. A copy of each contractor's substance abuse program must be

submitted to the Owner for approval prior to commencement of any work on the Project site.

The substance abuse program must apply to all employees working on the Project and subcontractors' of any of tier working on the Project site. This includes workers, new hires, replacement workers, and supervisory personnel. No employee or prospective employee of a Contractor shall be permitted to work on the Project site unless such employee has submitted to testing by this specification and unless the results of such testing are negative as hereinafter defined. The Contractor must provide the Owner with a Monthly Summary Report of the Substance Abuse Program compliance.

All Contractors must train their respective employees in methods that will allow them to recognize substance abusers. Supervisory Employees of the Owner or its subcontractor shall be trained to take action, and to confront a substance abuser in a manner consistent with generally accepted safety-training procedures.

The cost of implementing the Substance Abuse program shall be borne by each respective Contractor affected by this specification.

Suppliers, vendors, and visitors must become signatory to the terms of this specification and their abstinence from substance abuse, and their continued avoidance of violations of the specification at the project site. Furthermore, in the event of an incident and/or accident occurrences involving suppliers, vendors, and/or visitors, the same agrees to submit to the substance abuse testing when requested. Refusal to comply would be grounds to have the supplier, vendor, or visitor permanently barred from the Project site by regulators.

TESTING REQUIREMENTS

The Project requires:

- Post-offer/Pre-engagement drug and alcohol testing.
- Testing for reasonable suspicion of illegal drug use or alcohol use.
- Post accident and post incident drug and alcohol testing upon reasonable suspicion.
- Drug testing following discovery of illegal or unauthorized drugs or paraphernalia as creating reasonable suspicion.

All Prime Contractors must perform post-offer/pre-engagement, and post

accident/incident testing upon reasonable suspicion, as follows:

a. All drug testing must be conducted by a National Institute of Drug Abuse (NIDA) certified laboratory with test results interpreted by a licensed medical review officer (MRO).
b. The initial screen tests for alcohol shall be performed by using either a saliva test or breathalyzer test comparable to the type used by state or local law enforcement officials. Furthermore, alcohol confirmatory tests shall be performed by using either blood alcohol test or a Breathalyzer test comparable to the type used by state or local law enforcement officials.
c. Evidence of the negative test results of individual employees required by this specification shall be furnished to the Owner prior to the commencement of work by the individual employee and promptly after performance of any subsequent testing required by this specification. Acceptable negative test result format.
    - A certificate signed by the testing laboratory, setting forth the nature and results of performed; or
    - An identification card signed by the respective Prime Contractor and issued to the individual employee, setting forth as reported on a certificate issued by the testing laboratory. The name of the testing laboratory shall also appear on the identification card; provided the affected employee authorizes the issuance of such identification card.

COMPLIANCE PROCEDURE

The Owner reserves the right to audit any substance abuse program required by this specification to verify compliance results within twenty-four (24) hours of notification of the intent to audit. The Owner shall have free right of access to all relevant records of the Prime Contractor and their subcontractors and supplies for this purpose, provided such record disclosures are within the scope of the States guidelines pertaining to confidentiality of employee records.

The Contractor's pre-engagement employees who receive a positive test result shall immediately leave the Project Site. Transportation of employees receiving the positive test result is the direct responsibility of the employing Prime Contractor, including employees of its subcontractors. Furthermore, pre-engagement employees

receiving a positive test shall not be permitted to return to the Project Site earlier than 90 days from the date of the positive test. At this time the employee may begin the process outlined by this specification again.

DEFINITIONS/ CONFIDENTIALITY/RULES- DISCIPLINARY ACTIONS- GRIEVANCE PROCEDURES

1. DEFINITIONS:

(a) Company Premises - the term "Company Premises" as used in this policy includes all property, facilities, land, building, structures, automobiles, trucks and other vehicles owned, leased or used by the Contractor on the Project. Construction job sites for which the Contractor has responsibility are included.

(b) Prohibited Items & Substances - Prohibited substances include illegal drugs (including controlled substances, look alike drugs and designer drugs, alcoholic beverages, and drug paraphernalia in the possession of or being used by an employee on the job.

(c) Employee - Individuals, who perform work for the Contractor, including, but not limited to management, supervision, engineering, craft workers and clerical personnel.

(d) Accident - Any event resulting in injury to a person or property to which an employee, or contractor/contractor's employee, contributed as a direct or indirect cause.

(e) Incident - An event which has all the attributes of an accident, except that no harm was caused to person or property.

(f) Reasonable Cause - Reasonable cause shall be defined as tardiness, excessive absenteeism, and erratic behavior such as noticeable imbalance, incoherence, and disorientation.

2. CONFIDENTIALITY

(a) All parties to this policy and program have only the interests of employees in mind; therefore, encourage any employee with a substance abuse problem to come forward and voluntarily accept our assistance in dealing with the illness. An employee assistance program will provide guidance and direction for you during your recovery period. If you volunteer for help, the Contractor

will make every reasonable effort to return you to work upon your recovery. The Contractor will also take action to assure that your illness is handled in a confidential manner.

(b) All actions taken under this policy and program will be confidential and disclosed only to those with a "need to know."

(c) When a test is required, the specimen will be identified with a code number, not by name, to insure confidentiality of the donor. Each specimen container will be properly label and made tamper proof. The donor must witness this procedure.

(d) Unless an initial positive result is confirmed as positive, it shall be deemed negative and reported by the laboratory as such.

(e) The handling and transportation of each specimen will be properly documented through the strict chain of custody procedures.

3. RULES - all employees must report to work in a physical condition that will enable them to perform their jobs in a safe and efficient manner. Employees shall not:

(a) Use, possess, dispense or receive prohibited substances on or at the Project job site; or

(b) Report to work at or on the Project with any measurable amount of prohibited substances in their system.

4. DISCIPLINE - When the Contractor has reasonable cause to believe an employee is under the influence of a prohibited substance, for reasons of safety, the employee may be suspended until test results are available. If no test results are received after three (3) working days, the employee, if available, shall return to work with back pay. If the test results prove negative, the employee shall be reinstated with back pay. In all other cases:

(a) Applicants testing positive for drug use will not be hired.

(b) Employees who have not voluntarily come forward, and who test positive for a drug use, will be terminated.

(c) Employees who refuse to cooperate with testing procedures will be terminated.

(d) Employees found in possession of drugs or drug paraphernalia will be terminated.

(e) Employees found under the influence of alcohol while on duty, or while operating a company vehicle, will be subject to termination.

5. PRESCRIPTION DRUGS - Employees using a prescribed medication which, in their physician's opinion, may impair the performance of their duties, either mental or motor functions, must immediately inform the supervisor of such prescription drug use if instructed by their physician to do so. For the safety of all employees, the Contractor will consult with you and your physician to determine if a reassignment of duties is necessary. The Contractor will attempt to accommodate your needs by making an appropriate reassignment. However, if a reassignment is not possible, you will be placed on temporary medical leave until released as fit for duty by the prescribing physician.

Appendix B

Prevailing Wage Requirements and Rates

Overview

This project will utilize **Davis Bacon** prevailing wage rates. All contractors and subcontractors are required to comply with all Prevailing Wage Requirements in the Ohio Revised Code. These requirements are outlined below and sample documents are contained in the following pages and will be utilized to comply with these requirements. **Please note that the City of Canton will withhold payroll and/or retainage for a pay application or for the project in total until all prevailing wage issues are resolved.**

Payroll Dates Form

Must be submitted to the Prevailing Wage Coordinator (PWC) on or before the date your company starts work under the contract. It is to be completed with the **actual payroll dates** and not a day of the week. This requirement applies to all contractors/subcontractors.

Letter of Authorization for Payroll Signature

The person signing the certified payrolls must be an Owner or Corporate Officer of the company, or an Authorization letter must be completed and sent to the Prevailing Wage Coordinator. The document sent **must be** the **original signed notarized document**. If the person signing the payroll changes during the course of the project then a new Letter of Authorization for payroll signature must be submitted.

Fringe Benefits Form

Please complete and return along with the payroll dates form and letter of authorization for payroll signature form.

Notification to Employee Form

If your company is a **non-union company** you **must provide a completed Notification form to each employee working on this site and provide the PWC a copy** (wage and fringe benefit amounts on Notification must match amounts listed on payrolls), the form must have the Prevailing Wage Coordinator information, if you are a **union company** you need to send the PWC **a copy of the contract/agreement your company has with the local Trade Union(s)**.

Certified Payroll

The **first certified payroll** must be sent to the Prevailing Wage Coordinator **within two weeks of 1st pay period on the job**, payrolls must be sent **weekly** to the Prevailing Wage Coordinator. If paying fringe benefits in "cash," include the payment of fringes in the base rate of pay. If paying fringe benefits into bona fide "plans, funds, or programs," list the amounts paid into each plan/program on the certified payroll. If the payroll form you use does not have sections for fringe benefits, you must provide the information in the remarks section on the payroll or as an attachment to the certified payroll. Any payroll form/document the contractor uses must provide all of the required information as listed on the WH 347 payroll form. (**You must provide the original signed documents to the Prevailing Wage Coordinator before you will receive your final payment**.)

Affidavit of Compliance
When each contractor/subcontractor has completed their work on the job site they're required to submit a Final Affidavit of Compliance before the primary contractor receives their final payment and any retainer. Must send Prevailing Wage Coordinator original signed document.

Apprentices
Any/all apprentices working on this project must be registered with the State of Ohio Apprenticeship Council or the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprentiship and Training (BAT), apprentices on site cannot exceed ratios of apprentices/trainees to journeymen specified in the approved program. Contractors/subs must provide the Prevailing Wage Coordinator a copy of the Apprenticeship Agreement from the program for each apprentice on the project with the first payroll on which they appear. You must provide the apprentice level/year, i.e. 1, 2, 3, etc. and/or percent of Journeyman's pay rate, i.e. 50%, 55%, etc. on the certified payrolls.

Subcontractors
If any subcontractors will be used during this project then a list of subcontractors including their name, address, and phone number must be provided to the Prevailing Wage Coordinator. The Prime contractor is responsible for all forms to be furnished to subcontractors, **along with wage rates** or any other modification vital to the project.

Prevailing Wage Rates
Attached are the State of Ohio **Davis Bacon** wage rates that will apply to this project. All applicable prevailing wage rates must be posted on the job site for the duration of the project.

PAYROLL DATES

PREVAILING WAGE LAW

Instructions to the Contractor: Please read the following and provide the required information noted on this form. This document must be submitted to the Prevailing Wage Coordinator for the Public Authority on or before your company starts any work under a contract for a public improvement. This requirement is also applicable to your subcontractors. Please make a copy of this document available to them. The prevailing wage laws states that contractors are responsible for the actions of their subcontractors.

_____ will begin performance under contract on

(Name of Contractor)

the _____ project on _____

(Name of Project and Location) (Start Date)

and will conclude work on said project on _____

(Ending Date, If Known)

In accordance with section 4115.071(C) of the Ohio Revised Code; listing of payroll dates, I hereby submit the following schedule of dates that my company is required to pay wages to it's workers while on this project. (NOTE: If the life of the project is expected to be over (3) three months in length, provide only the days of the week your pay period starts and ends, plus the day you pay your workers)

_____ _____ _____

_____ _____ _____

_____ _____ _____

Day Pay Period Starts: _____

Day Pay Period Ends: _____

Day that Workers are Paid: _____

I acknowledge that I am required by section 4115.071(C) of the Ohio Revised Code that I must submit a copy of my company's certified payroll records for this project to the Prevailing Wage Coordinator of the Public Authority within two weeks of the initial pay date listed above. I further acknowledge that I am responsible to collect and submit my subcontractors prevailing wage documents, including their certified payroll records in accordance with law.

_____ _____ _____

Contractor Signature Date

_____

Company Name & Address

Example

PAYROLL DATES

Example

PREVAILING WAGE LAW

Instructions to the Contractor: Please read the following and provide the required information noted on this form. This document must be submitted to the Prevailing Wage Coordinator for the Public Authority on or before your company starts any work under a contract for a public improvement. This requirement is also applicable to your subcontractors. Please make a copy of this document available to them. The prevailing wage laws states that contractors are responsible for the actions of their subcontractors.

Donald P. Albrecht Inc. will begin performance under contract on
(Name of Contractor)

the Mahoning Road Economic Development project on 9/24/12
(Name of Project and Location) (Start Date)

and will conclude work on said project on 10/26/12
(Ending Date, If Known)

In accordance with section 4115.071(C) of the Ohio Revised Code; listing of payroll dates, I hereby submit the following schedule of dates that my company is required to pay wages to it's workers while on this project.
(NOTE: If the life of the project is expected to be over (3) three months in length, provide only the days of the week your pay period starts and ends, plus the day you pay your workers)

9/29/12	10/5/12	10/12/12
10/19/12	10/26/12	11/2/12
11/9/12		

Day Pay Period Starts: Sunday
Day Pay Period Ends: Saturday
Day that Workers are Paid: Friday

I acknowledge that I am required by section 4115.071(C) of the Ohio Revised Code that I must submit a copy of my company's certified payroll records for this project to the Prevailing Wage Coordinator of the Public Authority within two weeks of the initial pay date listed above. I further acknowledge that I am responsible to collect and submit my subcontractors prevailing wage documents, including their certified payroll records in accordance with law.

Contractor Signature

Donald P. Albrecht Inc.

9/19/12
Date

1025 Brook Ave. N.W.
Massillon, Ohio 44646
Company Name & Address

LETTER OF AUTHORIZATION FOR PAYROLL SIGNATURE:

DATE: _____

COMPANY NAME: _____

ADDRESS: _____

_____

FEDERAL I.D.# _____

GENTLEMEN:

RE: _____

(Project Name) (Project Number)

_____ Canton, Ohio 447

(Address)

_____ hereby authorizes

(Company Officer/ Owner – Title)

_____ as the person to complete and sign all certified payroll forms for the above project.

BY: _____

(Print Name)

_____

(Signature)

_____

(Title)

Sworn and subscribed in my presence this_____ day of _____ 20____

Seal :

_____

Notary Public

PREVAILING WAGE NOTIFICATION to EMPLOYEE

Project Name:	Job Number:
Contractor:	
Project Location	
Jobsite posting of Prevailing Wage rates located:	

Prevailing Wage Coordinator	Employee
Name:	Name:
Street: 218 Cleveland Ave SW	Street:
City: Canton	City:
State/Zip: Ohio 44702	State/Zip:
Phone:	Phone:

You will be performing work on this project that falls under these classifications. You will be paid the appropriate rate for the type of work you are performing.

Classification Be Specific: Laborer I (II, III) Operating Engineer I (II, III)	Prevailing Wage Rate Total Package	Minus your fringe benefits	Your hourly base rate

Hourly fringe benefits paid on your behalf by this Company:

Fringe	Amount	Fringe	Amount
Health Insurance		Vacation	
Life Insurance		Holiday	
Pension		Sick Pay	
Bonus		Training	
Other/ Cash		**Total Hourly Fringes**	

Contractor's Signature :	Date:
Employee's Signature :	Date:

FRINGE BENEFITS

PLEASE COMPLETE THIS FORM AND RETURN IT TO THE ADDRESS BELOW.

_____ FRINGE BENEFITS ARE ALL PAID IN CASH TO THE EMPLOYEE.

_____ FRINGE BENEFITS ARE PAID IN CASH AND TO THE BENEFIT PROGRAMS LISTED BELOW.

_____ FRINGE BENEFITS ARE ALL PAID TO THE FOLLOWING BENEFIT PROGRAMS:

HEALTH & WELFARE PLAN: _____

ADDRESS: _____

_____

PENSION PLAN: _____

ADDRESS: _____

_____

APPRENTICESHIP PROGRAM: _____

YOUR COMPANY IS: _____ UNION _____ NON-UNION

YOUR COMPANY PAYS ALL EMPLOYEES: _____ WEEKLY _____ BI-WEEKLY

FORWARD A BLANK FORM TO EACH SUBCONTRACTOR ON THE PROJECT FOR COMPLETION.
RETURN ALL FORMS TO:

CITY OF CANTON
218 CLEVELAND AVE SW
CANTON, OHIO 44702
ATTN: PREVAILING WAGE COORDINATOR

CONTRACTOR'S NAME: _____

ADDRESS: _____

PROJECT NAME: _____

U.S. Department of Labor
Wage and Hour Division

PAYROLL

(For Contractor's Optional Use; See Instructions at www.dol.gov/whd/forms/wh347instr.htm)

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

U.S. Wage and Hour Division
Rev. Dec. 2008
OMB No.: 1235-0008
Expires: 01/31/2015

NAME OF CONTRACTOR ☐ OR SUBCONTRACTOR ☐ | ADDRESS

PAYROLL NO | FOR WEEK ENDING | PROJECT AND LOCATION | PROJECT OR CONTRACT NO

(1) NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g. LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	OT OR ST	(4) DAY AND DATE — HOURS WORKED EACH DAY	(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS — FICA	WITH-HOLDING TAX			OTHER	TOTAL DEDUCTIONS	(9) NET WAGES PAID FOR WEEK
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While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that is will take an average of 55 minutes to complete this collection, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W. Washington, D.C. 20210

(over)

Date _____

I, _____ _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
(Contractor or Subcontractor)

_____, that during the payroll period commencing on the
(Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,

all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Start. 108, 72 Stat. 967, 76 Stat. 357, 40 U.S.C. § 3145), and described below:

_____

_____

_____

_____

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

☐ – In addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

☐ – Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.

Affidavit of Compliance

PREVAILING WAGES

I,_____

(Name of Person Signing Affidavit / Title)

do hereby certify that the wages paid to all employees of

_____

(Company Name)

for all hours worked on the

_____

(Project Name and Location)

project, during the period from _____to_____ are in

(Project Dates)

compliance with prevailing wage requirements of the contract between

_____and the City of Canton, Ohio.

I further certify that no rebates or deductions have or will be made, directly or indirectly, from any wages paid in connection with this project, other than those provided by law.

_____

(Signature of Officer or Agent)

Sworn to and subscribed in my presence this _____ day of _____, 20_____.

_____

(Notary Public)

The above affidavit must be executed and sworn to by the officer or agent of the contractor or subcontractor who supervises the payment of employees. This affidavit must be submitted before the surety is released or the final payment due under the terms of the contract is made.

Instructions For Completing Payroll Form, WH-347

- WH-347 (PDF)
  OMB Control No. 1235-0008, Expires 07/31/2024.

General: Form WH-347has been made available for the convenience of contractors and subcontractors required by their Federal or Federally-aided construction-type contracts and subcontracts to submit weekly payrolls. Properly filled out, this form will satisfy the requirements of Regulations, Parts 3 and 5 (29 C.F.R., Subtitle A), as to payrolls submitted in connection with contracts subject to the Davis-Bacon and related Acts.

While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) requires contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) Regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Under the Davis-Bacon and related Acts, the contractor is required to pay not less than prevailing wage, including fringe benefits, as predetermined by the Department of Labor. The contractor's obligation to pay fringe benefits may be met either by payment of the fringe benefits to bona fide benefit plans, funds or programs or by making payments to the covered workers (laborers and mechanics) as cash in lieu of fringe benefits.

This payroll provides for the contractor to show on the face of the payroll all monies to each worker, whether as basic rates or as cash in lieu of fringe benefits, and provides for the contractor's representation in the statement of compliance on the payroll (as shown on page 2) that he/she is paying for fringe benefits required by the contract and not paid as cash in lieu of fringe benefits. Detailed instructions concerning the preparation of the payroll follow:

Contractor or Subcontractor: Fill in your firm's name and check appropriate box.

Address: Fill in your firm's address.

Payroll No.: Beginning with the number "1", list the payroll number for the submission.

For Week Ending: List the workweek ending date.

Project and Location: Self-explanatory.

Project or Contract No.: Self-explanatory.

Column 1 - Name and Individual Identifying Number of Worker: Enter each worker's full name and an individual identifying number (e.g., last four digits of worker's social security number) on each weekly payroll submitted.

Column 2 - No. of Withholding Exemptions: This column is merely inserted for the employer's convenience and is not a requirement of Regulations, Part 3 and 5.

Column 3 - Work Classifications: List classification descriptive of work actually performed by each laborer or mechanic. Consult classification and minimum wage schedule set forth in contract specifications. If additional classifications are deemed necessary, see Contracting Officer or Agency representative. An individual may be shown as having worked in more than one classification provided an accurate breakdown or hours worked in each classification is maintained and shown on the submitted payroll by use of separate entries.

Column 4 - Hours worked: List the day and date and straight time and overtime hours worked in the applicable boxes. On all contracts subject to the Contract Work Hours Standard Act, enter hours worked in excess of 40 hours a week as "overtime".

Column 5 - Total: Self-explanatory

Column 6 - Rate of Pay (Including Fringe Benefits): In the "straight time" box for each worker, list the actual hourly rate paid for straight time worked, plus cash paid in lieu of fringe benefits paid. When recording the straight time hourly rate, any cash paid in lieu of fringe benefits may be shown separately from the basic rate. For example, "$12.25/.40" would reflect a $12.25 base hourly rate plus $0.40 for fringe benefits. This is of assistance in correctly computing overtime. See "Fringe Benefits" below. When overtime is worked, show the overtime hourly rate paid plus any cash in lieu of fringe benefits paid in the "overtime" box for each worker; otherwise, you may skip this box. See "Fringe Benefits" below. Payment of not less than time and one-half the basic or regular rate paid is required for overtime under the Contract Work Hours Standard Act of 1962 if the prime contract exceeds $100,000. In addition to paying no less than the predetermined rate for the classification which an individual works, the contractor must pay amounts predetermined as fringe benefits in the wage decision made part of the contract to approved fringe benefit plans, funds or programs or shall pay as cash in lieu of fringe benefits. See "FRINGE BENEFITS" below.

Column 7 - Gross Amount Earned: Enter gross amount earned on this project. If part of a worker's weekly wage was earned on projects other than the project described on this payroll, enter in column 7 first the amount earned on the Federal or Federally assisted project and then the gross amount earned during the week on all projects, thus "$163.00/$420.00" would reflect the earnings of a worker who earned $163.00 on a Federally assisted construction project during a week in which $420.00 was earned on all work.

Column 8 - Deductions: Five columns are provided for showing deductions made. If more than five deduction are involved, use the first four columns and show the balance deductions under "Other" column; show actual total under "Total Deductions" column; and in the attachment to the payroll describe the deduction(s) contained in the "Other" column. All deductions must be in accordance with the provisions of the Copeland Act Regulations, 29 C.F.R., Part 3. If an individual worked on other jobs in addition to this project, show actual deductions from his/her weekly gross wage, and indicate that deductions are based on his gross wages.

Column 9 - Net Wages Paid for Week: Self-explanatory.

Totals - Space has been left at the bottom of the columns so that totals may be shown if the contractor so desires.

Statement Required by Regulations, Parts 3 and 5: While the "statement of compliance" need not be notarized, the statement (on page 2 of the payroll form) is subject to the penalties provided by 18 U.S.C. § 1001, namely, a fine, possible imprisonment of not more than 5 years, or both. Accordingly, the party signing this statement should have knowledge of the facts represented as true.

Items 1and 2: Space has been provided between items (1) and (2) of the statement for describing any deductions made. If all deductions made are adequately described in the "Deductions" column above, state "*See* Deductions column in this payroll." *See* "FRINGE BENEFITS" below for instructions concerning filling out paragraph 4 of the statement.

Item 4 FRINGE BENEFITS - Contractors who pay all required fringe benefits: If paying all fringe benefits to approved plans, funds, or programs in amounts not less than were determined in the applicable wage decision of the Secretary of Labor, show the basic cash hourly rate and overtime rate paid to each worker on the face of the payroll and check paragraph 4(a) of the statement on page 2 of the WH-347 payroll form to indicate the payment. Note any exceptions in section 4(c).

Contractors who pay no fringe benefits: If not paying all fringe benefits to approved plans, funds, or programs in amounts of at least those that were determined in the applicable wage decision of the Secretary of Labor, pay any remaining fringe benefit amount to each laborer and mechanic and insert in the "straight time" of the "Rate of Pay" column of the payroll an amount not less than the predetermined rate for each classification plus the amount of fringe benefits determined for each classification in the application wage decision. Inasmuch as it is not necessary to pay time and a half on cash paid in lieu of fringe benefits, the overtime rate shall be not less than the sum of the basic predetermined rate, plus the half time premium on basic or regular rate, plus the required cash in lieu of fringe benefits at the straight time rate. In addition, check paragraph 4(b) of the statement on page 2 the payroll form to indicate the payment of fringe benefits in cash directly to the workers. Note any exceptions in section 4(c).

Use of Section 4(c), Exceptions

Any contractor who is making payment to approved plans, funds, or programs in amounts less than the wage determination requires is obliged to pay the deficiency directly to the covered worker as cash in lieu of fringe benefits. Enter any exceptions to section 4(a) or 4(b) in section 4(c). Enter in the Exception column the craft, and enter in the Explanation column the hourly amount paid each worker as cash in lieu of fringe benefits and the hourly amount paid to plans, funds, or programs as fringe benefits. The contractor must pay an amount not less than the predetermined rate plus cash in lieu of fringe benefits as shown in section 4(c) to each such individual for all hours worked (unless otherwise provided by applicable wage determination) on the Federal or Federally assisted project. Enter the rate paid and amount of cash paid in lieu of fringe benefits per hour in column 6 on the payroll. See paragraph on "Contractors who pay no fringe benefits" for computation of overtime rate.

Public Burden Statement: We estimate that it will take an average of 55 minutes to complete this collection of information, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection of information, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W.,Washington, D.C. 20210.

Note: In order to view, fill out, and print PDF forms, you need Adobe® Acrobat® Reader® version 5 or later, which you may download for free at www.adobe.com/products/acrobat/readstep2.html.

A. APPLICABILITY

The Project or Program to which the construction work covered by this Contract pertains is being assisted by the United States of America, and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such Federal assistance.

(1) MINIMUM WAGES

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment, computed at rates not less than those contained in the wage determination of the Secretary of Labor (which is attached hereto and made a part hereof), regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR 5.5(a)(1)(ii) and the Davis-Bacon poster (WH1321)) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place, where it can be easily seen by the workers.

(ii) Additional Classifications.

(A) Any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. HUD shall approve an additional classification and wage rate and fringe benefits therefor only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination;

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor, the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by HUD or its designee to the Administrator of the Wage and Hour Division ("Administrator"), Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget ("OMB") under OMB control number 1235-0023.)

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, or HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1235-0023.)

(D) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (1)(ii)(B) or (C) of this paragraph, shall be paid to all workers performing work in the classification under this Contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB Control Number 1235-0023.)

(2) Withholding. HUD or its designee shall, upon its own action or upon written request of an authorized representative of the U.S. Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee or helper, employed or working on the site of the work, all or part of the wages required by the contract, HUD or its designee may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased. HUD or its designee may, after written notice to the contractor, disburse such amounts withheld for and on account of the contractor or subcontractor to the respective employees to whom they are due. The Department of Labor shall make such disbursements in the case of direct Davis-Bacon Act contracts.

(3) Payrolls and basic records.

(i) Maintaining Payroll Records. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification(s), hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid.

Whenever the Secretary of Labor has found, under 29 CFR 5.5(a)(1)(iv), that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits.

Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs. (Approved by the Office of Management and Budget under OMB Control Numbers 1235-0023 and 1215-0018)

(ii) Certified Payroll Reports.

(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to HUD or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead, the payrolls only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at **https://www.dol.gov/agencies/whd/forms** or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to HUD or its designee, the contractor, or the Wage and Hour Division of the U.S. Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this subparagraph for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to HUD or its designee. (Approved by the Office of Management and Budget under OMB Control Number 1235-0008.)

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR 5.5(a)(3)(i), and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract; and

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (a)(3)(ii)(b).

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under subparagraph (a)(3)(i) available for inspection, copying, or transcription by authorized representatives of HUD or its designee or the U.S. Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, HUD or its designee may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency (where appropriate), to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program.

If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringe benefits shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed, unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees, and journeymen under 29 CFR Part 5 shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this Contract.

(6) Subcontracts. The contractor or subcontractor will insert in any subcontracts the clauses contained in subparagraphs (1) through (11) in this paragraph (a) and such other clauses as HUD or its designee may, by appropriate instructions, require, and a copy of the applicable prevailing wage decision, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in this paragraph.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act Requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this Contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this Contract shall not be subject to the general disputes clause of this Contract. Such disputes shall be resolved in accordance with the procedures of the U.S. Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and HUD or its designee, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of Eligibility.

(i) By entering into this Contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(ii) No part of this Contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(iii) Anyone who knowingly makes, presents, or submits a false, fictitious, or fraudulent statement, representation or certification is subject to criminal, civil and/or administrative sanctions, including fines, penalties, and imprisonment (e.g., 18 U.S.C. §§ 287, 1001, 1010, 1012; 31 U.S.C. §§ 3729, 3802.

(11) **Complaints, Proceedings, or Testimony by Employees.** No laborer or mechanic, to whom the wage, salary, or other labor standards provisions of this Contract are applicable, shall be discharged or in any other manner discriminated against by the contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this Contract to his employer.

B. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The provisions of this paragraph (b) are applicable where the amount of the prime contract exceeds **$100,000**. As used in this paragraph, the terms "laborers" and "mechanics" include watchmen and guards.

(1) **Overtime requirements.** No contractor or subcontractor contracting for any part of the contract work, which may require or involve the employment of laborers or mechanics, shall require or permit any such laborer or mechanic in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek, unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(2) **Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the clause set forth in subparagraph B(1) of this paragraph, the contractor, and any subcontractor responsible therefor, shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in subparagraph B(1) of this paragraph, in the sum of **$27** for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in subparagraph B(1) of this paragraph. In accordance with the Federal Civil Penalties Inflation Adjustment Act of 1990 (28 U.S.C. § 2461 Note), the Department of Labor adjusts this civil monetary penalty for inflation no later than January 15 each year.

(3) **Withholding for unpaid wages and liquidated damages.** HUD or its designee shall, upon its own action or upon written request of an authorized representative of the U.S. Department of Labor, withhold or cause to be withheld from any moneys payable on account of work performed by the contractor or subcontractor under any such contract, or any other Federal contract with the same prime contract, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages, as provided in the clause set forth in subparagraph B(2) of this paragraph.

(4) **Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph B(1) through (4) of this paragraph and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in subparagraphs B(1) through (4) of this paragraph.

C. HEALTH AND SAFETY

The provisions of this paragraph (c) are applicable where the amount of the prime contract exceeds **$100,000**.

(1) No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his or her health and safety, as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

(2) The contractor shall comply with all regulations issued by the Secretary of Labor pursuant to 29 CFR Part 1926 and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act, (Public Law 91-54, 83 Stat 96), 40 U.S.C. § 3701 et seq.

(3) The contractor shall include the provisions of this paragraph in every subcontract, so that such provisions will be binding on each subcontractor. The contractor shall take such action with respect to any subcontractor as the Secretary of Housing and Urban Development or the Secretary of Labor shall direct as a means of enforcing such provisions.

"General Decision Number: OH20220001 04/08/2022

Superseded General Decision Number: OH20210001

State: Ohio

Construction Types: Heavy and Highway

Counties: Ohio Statewide.

Heavy and Highway Construction Projects

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $15.00 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2022.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $11.25 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the

Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at https://www.dol.gov/agencies/whd/government-contracts.

Modification Number	Publication Date
0	01/07/2022
1	01/14/2022
2	01/28/2022
3	02/18/2022
4	02/25/2022
5	03/11/2022
6	04/08/2022

BROH0001-001 06/01/2021

DEFIANCE, FULTON (Excluding Fulton, Amboy & Swan Creek Townships), HENRY (Excluding Monroe, Bartlow, Liberty, Washington, Richfield, Marion, Damascus & Townships & that part of Harrison Township outside corporate limits of city of Napoleon), PAULDING, PUTNAM and WILLIAMS COUNTIES

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.55

BROH0001-004 06/01/2021

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 30.40	17.55

BROH0003-002 06/01/2021

FULTON (Townships of Amboy, Swan Creek & Fulton), HENRY (Townships of Washington, Damascus, Richfield, Bartlow, Liberty, Harrison, Monroe, & Marion), LUCAS and WOOD (Townships of Perrysburg, Ross, Lake, Troy, Freedom, Montgomery, Webster, Center, Portage, Middleton, Plain, Liberty, Henry, Washington, Weston, Milton, Jackson & Grand Rapids) COUNTIES

	Rates	Fringes

Bricklayer, Stonemason.....$ 30.40 17.55

BROH0005-003 06/01/2020

CUYAHOGA, LORAIN & MEDINA (Hinckley, Granger, Brunswick, Liverpool, Montville, York, Homer, Harrisville, Chatham, Litchfield & Spencer Townships and the city of Medina)

	Rates	Fringes
BRICKLAYER		
BRICKLAYERS; CAULKERS; CLEANERS; POINTERS; & STONEMASONS	$ 36.64	17.13
SANDBLASTERS	$ 36.39	17.13
SEWER BRICKLAYERS & STACK BUILDERS	$ 36.64	17.13
SWING SCAFFOLDS	$ 37.14	17.13

BROH0006-005 06/01/2021

CARROLL, COLUMBIANA (Knox, Butler, West & Hanover Townships), STARK & TUSCARAWAS

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.55

BROH0007-002 06/01/2021

LAWRENCE

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.55

BROH0007-005 06/01/2021

PORTAGE & SUMMIT

	Rates	Fringes
BRICKLAYER	$ 30.40	17.55

BROH0007-010 06/01/2017

PORTAGE & SUMMIT

	Rates	Fringes
MASON - STONE	$ 28.65	14.55

BROH0008-001 06/01/2021

COLUMBIANA (Salem, Perry, Fairfield, Center, Elk Run, Middleton, & Unity Townships and the city of New Waterford), MAHONING & TRUMBULL

	Rates	Fringes
BRICKLAYER	$ 30.40	17.55

BROH0009-002 06/01/2021

BELMONT & MONROE COUNTIES and the Townships of Warren & Mt. Pleasant and the Village of Dillonvale in JEFFERSON COUNTY

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.55
Refractory	$ 31.45	19.01

BROH0010-002 06/01/2021

COLUMBIANA (St. Clair, Madison, Wayne, Franklin, Washington, Yellow Creek & Liverpool Townships) & JEFFERSON (Brush Creek & Saline Townships)

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.55

BROH0014-002 06/01/2021

HARRISON & JEFFERSON (Except Mt. Pleasant, Warren, Brush Creek, Saline & Salineville Townships & the Village of Dillonvale)

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.55

BROH0016-002 06/01/2021

ASHTABULA, GEAUGA, and LAKE COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0018-002 06/01/2021

BROWN, BUTLER, CLERMONT, HAMILTON, PREBLE (Gasper, Dixon, Israel, Lanier, Somers & Gratis Townships) & WARREN COUNTIES:

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0022-004 06/01/2021

CHAMPAIGN, CLARK, CLINTON, DARKE, GREENE, HIGHLAND, LOGAN, MIAMI, MONTGOMERY, PREBLE (Jackson, Monroe, Harrison, Twin, Jefferson & Washington Townships) and SHELBY COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0032-001 06/01/2021

GALLIA & MEIGS

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0035-002 06/01/2021

ALLEN, AUGLAIZE, MERCER and VAN WERT COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0039-002 06/01/2021

ADAMS & SCIOTO

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0040-003 06/01/2021

ASHLAND, CRAWFORD, HARDIN, HOLMES, MARION, MORROW, RICHLAND, WAYNE and WYANDOT (Except Crawford, Ridge, Richland & Tymochtee Townships) COUNTIES

	Rates	Fringes
Bricklayer, Stonemason	$ 31.93	22.54

FOOTNOTE: Layout Man and Sawman rate: $1.00 per hour above journeyman rate.
Free standing stack work ground level to top of stack; Sandblasting and laying of carbon masonry material in swing stage and/or scaffold; Ramming and spading of plastics and gunniting: $1.50 per hour above journeyman rate.
""Hot"" work: $2.50 above journeyman rate.

BROH0044-002 06/01/2021

	Rates	Fringes
Bricklayer, Stonemason COSHOCTON, FAIRFIELD, GUERNSEY, HOCKING, KNOX, KICKING, MORGAN, MUSKINGUM, NOBLE (Beaver, Buffalo, Seneca & Wayne Townships) & PERRY COUNTIES:	$ 30.40	17.55

BROH0045-002 06/01/2021

FAYETTE, JACKSON, PIKE, ROSS and VINTON COUNTIES

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.66

BROH0046-002 06/01/2021

ERIE, HANCOCK, HURON, OTTAWA, SANDUSKY, SENECA, WOOD (Perry & Bloom Townships) and WYANDOT (Tymochtee, Crawford, Ridge & Richland Townships) COUNTIES & the Islands of Lake Erie north of Sandusky

	Rates	Fringes

Bricklayer, Stonemason.....$ 30.40 17.55

FOOTNOTE: Layout Man and Sawman rate: $1.00 per hour above journeyman rate.
Free standing stack work ground level to top of stack; Sandblasting and laying of carbon masonry material in swing stage and/or scaffold; Ramming and spading of plastics and gunniting: $1.50 per hour above journeyman rate.
""Hot"" work: $2.50 above journeyman rate.

BROH0052-001 06/01/2021

ATHENS COUNTY

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0052-003 06/01/2021

NOBLE (Brookfield, Noble, Center, Sharon, Olive, Enoch, Stock, Jackson, Jefferson & Elk Townships) and WASHINGTON COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

BROH0055-003 06/01/2021

DELAWARE, FRANKLIN, MADISON, PICKAWAY and UNION COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 30.40	17.55

CARP0003-004 05/01/2017

MAHONING & TRUMBULL

	Rates	Fringes
CARPENTER.....	$ 26.20	17.42

CARP0069-003 05/01/2017

CARROLL, STARK, TUSCARAWAS & WAYNE

	Rates	Fringes
CARPENTER	$ 25.98	15.98

CARP0069-006 05/01/2017

COSHOCTON, HOLMES, KNOX & MORROW

	Rates	Fringes
CARPENTER	$ 24.04	15.29

CARP0171-002 05/01/2019

BELMONT, COLUMBIANA, HARRISON, JEFFERSON & MONROE

	Rates	Fringes
CARPENTER	$ 27.37	20.02

CARP0200-002 05/01/2021

ADAMS, ATHENS, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GUERNSEY, HIGHLAND, HOCKING, JACKSON, LAWRENCE, LICKING, MADISON, MARION, MEIGS, MORGAN, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, ROSS, SCIOTO, UNION, VINTON and WASHINGTON COUNTIES

	Rates	Fringes
CARPENTER	$ 30.28	20.08
Diver	$ 39.41	10.40
PILEDRIVERMAN	$ 30.28	20.08

CARP0248-005 07/01/2008

LUCAS & WOOD

	Rates	Fringes
CARPENTER	$ 27.27	14.58

CARP0248-008 07/01/2008

	Rates	Fringes
CARPENTER DEFIANCE, FULTON, HANCOCK, HENRY, PAULDING & WILLIAMS		

COUNTIES	$ 23.71	13.28

CARP0254-002 05/01/2017

ASHTABULA, CUYAHOGA, GEAUGA & LAKE

	Rates	Fringes
CARPENTER	$ 32.40	16.97

CARP0372-002 05/01/2016

ALLEN, AUGLAIZE, HARDIN, MERCER, PUTNAM & VAN WERT

	Rates	Fringes
CARPENTER	$ 24.54	18.21

CARP0639-003 05/01/2017

MEDINA, PORTAGE & SUMMIT

	Rates	Fringes
CARPENTER	$ 30.42	16.99

CARP0735-002 05/01/2019

ASHLAND, ERIE, HURON, LORAIN & RICHLAND

	Rates	Fringes
CARPENTER	$ 26.30	17.91

CARP1311-001 05/01/2017

BROWN, BUTLER, CHAMPAIGN, CLARK, CLERMONT, CLINTON, DARKE, GREENE, HAMILTON, LOGAN, MIAMI, MONTGOMERY, PREBLE, SHELBY & WARREN

	Rates	Fringes
Carpenter & Piledrivermen	$ 29.34	15.95
Diver	$ 40.58	9.69

CARP1393-002 07/01/2008

CRAWFORD, DEFIANCE, FULTON, HANCOCK, HENRY, LUCAS, OTTAWA, PAULDING, SANDUSKY, SENECA, WILLIAMS & WOOD

	Rates	Fringes
Piledrivermen & Diver's Tender	$ 27.30	16.05

DIVERS - $250.00 per day

CARP1393-003 07/01/2008

ALLEN, AUGLAIZE, HARDIN, MERCER, PUTNAM, VAN WERT & WYANDOT

	Rates	Fringes
Piledrivermen & Diver's Tender	$ 25.15	15.92

DIVERS - $250.00 per day

CARP1871-006 05/01/2017

BELMONT, HARRISON, & MONROE

	Rates	Fringes
Diver, Wet	$ 48.11	17.33
Piledrivermen; Diver, Dry	$ 32.07	17.33

CARP1871-008 05/01/2017

ASHLAND, ASHTABULA, CUYAHOGA, ERIE, GEAUGA, HURON, LAKE, LORAIN, MEDINA, PORTAGE, RICHLAND & SUMMIT

	Rates	Fringes
Diver, Wet	$ 45.80	18.84
Piledrivermen; Diver, Dry	$ 30.53	18.84

CARP1871-014 05/01/2017

CARROLL, STARK, TUSCARAWAS & WAYNE

	Rates	Fringes
Diver, Wet	$ 38.34	16.95
Piledrivermen; Diver, Dry	$ 25.56	16.95

CARP1871-015 05/01/2017

COSHOCTON, HOLMES, KNOX & MORROW

	Rates	Fringes
Diver, Wet	$ 37.34	16.07
Piledrivermen; Diver, Dry	$ 24.89	16.07

CARP1871-017 05/01/2017

MAHONING & TRUMBULL

	Rates	Fringes
Diver, Wet	$ 40.65	17.62
Piledrivermen; Diver, Dry	$ 27.10	17.62

CARP2235-012 01/01/2014

COLUMBIANA & JEFFERSON

	Rates	Fringes
PILEDRIVERMAN	$ 31.74	16.41

CARP2239-001 07/01/2008

CRAWFORD, OTTAWA, SANDUSKY, SENECA & WYANDOT

	Rates	Fringes
CARPENTER	$ 23.71	13.28

ELEC0008-002 05/24/2021

DEFIANCE, FULTON, HANCOCK, HENRY, LUCAS, OTTAWA, PAULDING, PUTNAM, SANDUSKY, SENECA, WILLIAMS & WOOD

	Rates	Fringes
CABLE SPLICER	$ 38.98	18.96
ELECTRICIAN	$ 43.33	26.61

ELEC0032-003 12/06/2021

ALLEN, AUGLAIZE, HARDIN, LOGAN, MERCER, SHELBY, VAN WERT & WYANDOT (Crawford, Jackson, Marseilles, Mifflin, Ridgeland, Ridge & Salem Townships)

	Rates	Fringes

ELECTRICIAN.....$ 33.22 19.73

ELEC0038-002 04/26/2021

CUYAHOGA, GEAUGA (Bainbridge, Chester & Russell Townships) & LORAIN (Columbia Township)

	Rates	Fringes
ELECTRICIAN		
Excluding Sound & Communications Work	$ 40.63	21.74

FOOTNOTES;
a. 6 Paid Holidays: New Year's Day; Memorial Day; July 4th; Labor Day; Thanksgiving Day; & Christmas Day
b. 1 week's paid vacation for 1 year's service; 2 weeks' paid vacation for 2 or more years' service

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ELEC0038-008 04/26/2021

CUYAHOGA, GEAUGA (Bainbridge, Chester & Russell Townships) & LORAIN (Columbia Township)

	Rates	Fringes
Sound & Communication Technician		
Communications Technician	$ 28.80	12.77
Installer Technician	$ 27.55	12.77

FOOTNOTES;
a. 6 Paid Holidays: New Year's Day; Memorial Day; July 4th; Labor Day; Thanksgiving Day; & Christmas Day
b. 1 week's paid vacation for 1 year's service; 2 weeks' paid vacation for 2 or more years' service

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ELEC0064-003 11/29/2021

COLUMBIANA (Butler, Fairfield, Perry, Salem & Unity Townships) MAHONING (Austintown, Beaver, Berlin, Boardman, Canfield, Ellsworth, Coitsville, Goshen, Green, Jackson, Poland, Springfield & Youngstown Townships), & TRUMBULL (Hubbard & Liberty Townships)

	Rates	Fringes
ELECTRICIAN.....	$ 36.10	18.17

ELEC0071-001 01/01/2019

ASHLAND, CHAMPAIGN, CLARK, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HIGHLAND, HOCKING, JACKSON (Coal, Jackson, Liberty, Milton, Washington & Wellston Townships), KNOX, LICKING, MADISON, MARION, MONROE, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE (Beaver, Benton, Jackson, Mifflin, Pebble, Peepee, Perry & Seal Townships), RICHLAND, ROSS, TUSCARAWAS (Auburn, Bucks, Clay, Jefferson, Oxford, Perry, Salem, Rush, Washington & York Townships), UNION, VINTON (Clinton, Eagle, Elk, Harrison, Jackson, Richland & Swan Townships), and WASHINGTON COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operators.....	$ 33.62	13.40
Groundmen.....	$ 24.17	11.32
Linemen & Cable Splicers....	$ 38.27	14.42

ELEC0071-004 01/01/2019

AUGLAIZE, CLINTON, DARKE, GREENE, LOGAN, MERCER, MIAMI, MONTGOMERY, PREBLE, and SHELBY COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator.....	$ 33.62	13.40
Groundman.....	$ 24.17	11.32
Lineman & Cable Splicers....	$ 38.27	14.42

ELEC0071-005 12/31/2018

ASHTABULA, CUYAHOGA, GEAUGA, LAKE & LORAIN

	Rates	Fringes
LINE CONSTRUCTION: Equipment Operator		
DOT/Traffic Signal & Highway Lighting Projects...	$ 32.44	14.10
Municipal Power/Transit		

Projects	$ 40.10	16.42
LINE CONSTRUCTION: Groundman		
DOT/Traffic Signal & Highway Lighting Projects	$ 25.06	12.26
Municipal Power/Transit Projects	$ 31.19	14.11
LINE CONSTRUCTION: Linemen/Cable Splicer		
DOT/Traffic Signal & Highway Lighting Projects	$ 36.13	15.03
Municipal Power/Transit Projects	$ 44.56	17.58

ELEC0071-008 01/01/2019

COLUMBIANA, MAHONING, and TRUMBULL COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0071-010 01/01/2019

BELMONT, CARROLL, HARRISON, HOLMES, JEFFERSON, MEDINA, PORTAGE, STARK, SUMMIT, and WAYNE COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0071-013 01/01/2019

BROWN, BUTLER, CLERMONT, HAMILTON, and WARREN COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0071-014 01/01/2019

ADAMS, ATHENS, GALLIA, JACKSON (Bloomfield, Franklin, Hamilton, Lick, Jefferson, Scioto & Madison Townships), LAWRENCE, MEIGS, PIKE (Camp Creek, Marion, Newton, Scioto, Sunfish & Union Townships), SCIOTO & VINTON (Brown, Knox, Madison, Vinton & Wilkesville Townships)

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0082-002 11/29/2021

CLINTON, DARKE, GREENE, MIAMI, MONTGOMERY, PREBLE & WARREN (Wayne, Clear Creek & Franklin Townships)

	Rates	Fringes
ELECTRICIAN	$ 33.25	20.84

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* ELEC0082-006 11/29/2021

CLINTON, DARKE, GREENE, MIAMI, MONTGOMERY, PREBLE & WARREN (Wayne, Clear Creek & Franklin Townships)

	Rates	Fringes
Sound & Communication Technician		
Cable Puller	$ 12.98 **	3.89
Installer/Technician	$ 25.95	12.27

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* ELEC0129-003 02/28/2022

LORAIN (Except Columbia Township) & MEDINA (Litchfield & Liverpool Townships)

	Rates	Fringes
ELECTRICIAN	$ 37.00	18.23

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* ELEC0129-004 02/28/2022

ERIE & HURON (Lyme, Ridgefield, Norwalk, Townsend, Wakeman,

Sherman, Peru, Bronson, Hartland, Clarksfield, Norwich,
Greenfield, Fairfield, Fitchville & New London Townships)

	Rates	Fringes
ELECTRICIAN	$ 37.00	18.23

ELEC0141-003 09/01/2019

BELMONT COUNTY

	Rates	Fringes
CABLE SPLICER	$ 30.63	25.87
ELECTRICIAN	$ 30.38	25.87

ELEC0212-003 11/26/2018

BROWN, CLERMONT & HAMILTON

	Rates	Fringes
Sound & Communication Technician	$ 24.35	10.99

ELEC0212-005 11/29/2021

BROWN, CLERMONT, and HAMILTON COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 37.04	20.64

ELEC0245-001 01/01/2022

ALLEN, HARDIN, VAN WERT & WYANDOT (Crawford, Jackson,
Marseilles, Mifflin, Richland, Ridge & Salem Townships)

	Rates	Fringes
Line Construction		
Equipment Operator	$ 32.37	26.5%+7.25
Groundman Truck Driver	$ 18.60	26.5%+7.25
Lineman	$ 42.52	26.5%+7.25

FOOTNOTE: a. Half day's Paid Holiday: The last 4 hours of the workday prior to Christmas or New Year's Day

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ELEC0245-003 01/01/2022

DEFIANCE, FULTON, HANCOCK, HENRY, HURON, LUCAS, OTTAWA,
PAULDING, PUTNAM, SANDUSKY, SENECA, WILLIAMS, and WOOD COUNTIES

	Rates	Fringes
Line Construction		
Cable Splicer	$ 48.90	26.5%+7.25
Groundman/Truck Driver	$ 18.60	26.5%+7.25
Heli-arc Welding	$ 40.76	26.5%+7.25
Lineman	$ 45.52	26.5%+7.25
Operator - Class 1	$ 34.18	26.5%+7.25
Operator - Class 2	$ 28.32	26.5%+7.25
Traffic Signal & Lighting Technician	$ 38.27	26.5%+7.25

FOOTNOTE: a. 6 Observed Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; & Christmas Day. Employees who work on a holiday shall be paid at a rate of double their applicable classified straight-time rates for the work performed on such holiday.

ELEC0245-004 01/01/2022

ERIE COUNTY

	Rates	Fringes
Line Construction		
Cable Splicer	$ 49.14	26.75%+6.75
Cablesplicer	$ 48.90	26.5%+7.25
Groundman/Truck Driver	$ 18.60	26.5%+7.25
Lineman	$ 42.52	26.5%+7.25
Operator - Class 1	$ 34.14	26.5%+7.25
Operator - Class 2	$ 28.32	26.5%+7.25

FOOTNOTE: a. 6 Observed Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; & Christmas Day. Employees who work on a holiday shall be paid at a rate of double their applicable classified straight-time rates for the work performed on such holiday.

ELEC0246-001 10/29/2018

	Rates	Fringes

ELECTRICIAN.....$ 38.00 84%+a

FOOTNOTE: a. 1 1/2 Paid Holidays: The last scheduled workday prior to Christmas & 4 hours on Good Friday.

ELEC0306-005 05/28/2018

MEDINA (Brunswick, Chatham, Granger, Guilford, Harrisville, Hinckley, Homer, Lafayette, Medina, Montville, Sharon, Spencer, Wadsworth, Westfield & York Townships), PORTAGE (Atwater, Aurora, Brimfield, Deerfield, Franklin, Mantua, Randolph, Ravenna, Rootstown, Shalersville, Streetsboro & Suffield Townships), SUMMIT & WAYNE (Baughman, Canaan, Chester, Chippewa, Congress, Green, Milton, & Wayne Townships)

	Rates	Fringes
CABLE SPLICER	$ 36.87	16.56
ELECTRICIAN	$ 34.54	5%+18.06

ELEC0317-002 06/01/2021

GALLIA & LAWRENCE

	Rates	Fringes
CABLE SPLICER	$ 32.68	18.13
ELECTRICIAN	$ 35.10	27.47

ELEC0540-005 12/27/2021

CARROLL (Northern half, including Fox, Harrison, Rose & Washington Townhships), COLUMBIANA (Knox Township), HOLMES, MAHONING (Smith Township), STARK, TUSCARAWAS (North of Auburn, Clay, Rush & York Townships), and WAYNE (South of Baughman, Chester, Green & Wayne Townships) COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 35.28	22.63

ELEC0573-003 11/29/2021

ASHTABULA (Colebrook, Wayne, Williamsfield, Orwell & Windsor Townships), GEAUGA (Auburn, Middlefield, Parkman & Troy Townships), MAHONING (Milton Township), PORTAGE (Charlestown,

Edinburg, Freedom, Hiram, Nelson, Palmyra, Paris & Windham Townships), and TRUMBULL (Except Liberty & Hubbard Townships)

	Rates	Fringes
ELECTRICIAN	$ 37.04	20.64

ELEC0575-001 11/29/2021

ADAMS, FAYETTE, HIGHLAND, HOCKING, JACKSON (Bloomfield, Franklin, Hamilton, Jefferson, Lick, Madison, Scioto, Coal, Jackson, Liberty, Milton & Washington Townships), PICKAWAY (Deer Creek, Perry, Pickaway, Salt Creek & Wayne Townships), PIKE (Beaver, Benton, Jackson, Mifflin, Pebble, PeePee, Perry, Seal, Camp Creek, Newton, Scioto, Sunfish, Union & Marion Townships), ROSS, SCIOTO & VINTON (Clinton, Eagle, Elk, Harrison, Jackson, Richland & Swan Townships)

	Rates	Fringes
ELECTRICIAN	$ 35.00	19.76

ELEC0648-001 08/30/2021

BUTLER and WARREN COUNTIES (Deerfield, Hamilton, Harlan, Massie, Salem, Turtle Creek, Union & Washington Townships)

	Rates	Fringes
CABLE SPLICER	$ 30.50	18.23
ELECTRICIAN	$ 32.00	20.79

ELEC0673-004 02/01/2020

ASHTABULA (Excluding Orwell, Colebrook, Williamsfield, Wayne & Windsor Townships), GEAUGA (Burton, Chardon, Claridon, Hambden, Huntsburg, Montville, Munson, Newbury & Thompson Townships) and LAKE COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 33.81	21.47
ELECTRICIAN	$ 33.56	21.47

ELEC0683-002 05/31/2021

CHAMPAIGN, CLARK, DELAWARE, FAIRFIELD, FRANKLIN, MADISON, PICKAWAY (Circleville, Darby, Harrison, Jackson, Madison, Monroe, Muhlenberg, Scioto, Walnut & Washington Townships), and UNION COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 35.50	21.99
ELECTRICIAN	$ 35.50	21.99

ELEC0688-003 05/31/2021

ASHLAND, CRAWFORD, HURON (Richmond, New Haven, Ripley & Greenwich Townships), KNOX (Liberty, Clinton, Union, Howard, Monroe, Middleberry, Morris, Wayne, Berlin, Pike, Brown & Jefferson Townships), MARION, MORROW, RICHLAND and WYANDOT (Sycamore, Crane, Eden, Pitt, Antrim & Tymochtee Townships) COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 31.00	21.29

ELEC0972-002 06/01/2021

ATHENS, MEIGS, MONROE, MORGAN, NOBLE, VINTON (Brown, Knox, Madison, Vinton & Wilkesville Townships), and WASHINGTON COUNITES

	Rates	Fringes
CABLE SPLICER	$ 37.35	27.81
ELECTRICIAN	$ 34.30	27.62

ELEC1105-001 05/31/2021

COSHOCTON, GUERNSEY, KNOX (Jackson, Clay, Morgan, Miller, Milford, Hilliar, Butler, Harrison, Pleasant & College Townships), LICKING, MUSKINGUM, PERRY, and TUSCARAWAS (Auburn, York, Clay, Jefferson, Rush, Oxford, Washington, Salem, Perry & Bucks Townships) COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 34.25	21.15

ENGI0018-003 05/01/2019

ASHTABULA, CUYAHOGA, ERIE, GEAUGA, LAKE, LORAIN, MEDINA, PORTAGE, and SUMMIT COUNTIES

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 38.63	15.20
GROUP 2	$ 38.53	15.20
GROUP 3	$ 37.49	15.20
GROUP 4	$ 36.27	15.20
GROUP 5	$ 30.98	15.20
GROUP 6	$ 38.88	15.20
GROUP 7	$ 39.13	15.20

OPERATING ENGINEER CLASSIFICATIONS

GROUP 1 - Air Compressor on Steel Erection; Barrier Moving Machine; Boiler Operator on Compressor or Generator when mounted on a Rig; Cableway; Combination Concrete Mixer & Tower; Concrete Plant (over 4 yd. Capacity); Concrete Pump; Crane (All Types, Including Boom Truck, Cherry Picker); Crane-Compact, Track or Rubber over 4,000 lbs. capacity; Cranes-Self Erecting, Stationary, Track or Truck (All Configurations); Derrick; Dragline; Dredge (Dipper, Clam or Suction); Elevating Grader or Euclid Loader; Floating Equipment (All Types); Gradall; Helicopter Crew (Operator-Hoist or Winch); Hoe (all types); Hoisting Engine on Shaft or Tunnel Work; Hydraulic Gantry (Lifting System); Industrial-Type Tractor; Jet Engine Dryer (D8 or D9) Diesel Tractor; Locomotive (Standard Gauge); Maintenance Operator Class A; Mixer, Paving (Single or Double Drum); Mucking Machine; Multiple Scraper; Piledriving Machine (All Types); Power Shovel; Prentice Loader; Quad 9 (Double Pusher); Rail Tamper (with auto lifting & aligning device); Refrigerating Machine (Freezer Operation); Rotary Drill, on Caisson work; Rough Terrain Fork Lift with Winch/Hoist; Side-Boom; Slip-Form Paver; Tower Derrick; Tree Shredder; Trench Machine (Over 24"" wide); Truck Mounted Concrete Pump; Tug Boat; Tunnel Machine and/or Mining Machine; Wheel Excavator; and Asphalt Plant Engineer (Cleveland District Only).

GROUP 2 - Asphalt Paver; Automatic Subgrader Machine, Self-Propelled (CMI Type); Bobcat Type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Boring Machine More than 48""; Bulldozer; Endloader; Horizontal Directional Drill (Over 50,000 ft lbs thrust); Hydro

Milling Machine; Kolman-type Loader (production type-Dirt); Lead Greaseman; Lighting & Traffic Signal Installation Equipment (includes all groups or classifications); Material Transfer Equipment (Shuttle Buggy) Asphalt; Pettibone-Rail Equipment; Power Grader; Power Scraper; Push Cat; Rotomill (all), Grinders & Planers of All types; Trench Machine (24"" wide & under); Vermeer type Concrete Saw; and Maintenance Operators (Portage and Summit Counties Only).

GROUP 3 - A-Frame; Air Compressor on Tunnel Work (low pressure); Asphalt Plant Engineer (Portage and Summit Counties Only); Bobcat-type and/or Skid Steer Loader with or without Attachments; Highway Drills (all types); Locomotive (narrow gauge); Material Hoist/Elevator; Mixer, Concrete (more than one bag capacity); Mixer, one bag capacity (Side Loader); Power Boiler (Over 15 lbs. Pressure) Pump Operator installing & operating Well Points; Pump (4"" & over discharge); Roller, Asphalt; Rotovator (lime soil stabilizer); Switch & Tie Tampers (without lifting & aligning device); Utility Operator (Small equipment); Welding Machines; and Railroad Tie Inserter/Remover; Articulating/straight bed end dumps if assigned (minus $4.00 per hour.

GROUP 4 - Backfiller; Ballast Re-locator; Bars, Joint & Mesh Installing Machine; Batch Plant; Boring Machine Operator (48"" or less); Bull Floats; Burlap & Curing Machine; Concrete Plant (capacity 4 yd. & under); Concrete Saw (Multiple); Conveyor (Highway); Crusher; Deckhand; Farm-type Tractor with attachments (highway); Finishing Machine; Fireperson, Floating Equipment (all types); Forklift; Form Trencher; Hydro Hammer expect masonary; Hydro Seeder; Pavement Breaker; Plant Mixer; Post Driver; Post Hole Digger (Power Auger); Power Brush Burner; Power Form Handling Equipment; Road Widening Trencher; Roller (Brick, Grade & Macadam); Self-Propelled Power Spreader; Self-Propelled Power Subgrader; Steam Fireperson; Tractor (Pulling Sheepfoot, Roller or Grader); and Vibratory Compactor with Integral Power.

GROUP 5 - Compressor (Portable, Sewer, Heavy & Highway); Drum Fireperson (Asphalt Plant); Generator; Masonry Fork Lift; Inboard-Outboard Motor Boat Launch; Oil Heater (asphalt plant); Oiler/Helper; Power Driven Heater; Power Sweeper & Scrubber; Pump (under 4"" discharge); Signalperson; Tire Repairperson; VAC/ALLS; Cranes - Compact, track or rubber under 4,000 pound capacity; fueling and greasing; and Chainmen.

GROUP 6 - Master Mechanic & Boom from 150 to 180.

GROUP 7 - Boom from 180 and over.

ENGI0018-004 05/01/2019

ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LUCAS, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, and YANDOT COUNTIES

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 37.14	15.20
GROUP 2	$ 37.02	15.20
GROUP 3	$ 35.98	15.20
GROUP 4	$ 34.80	15.20
GROUP 5	$ 29.34	15.20
GROUP 6	$ 37.39	15.20
GROUP 7	$ 37.64	15.20

OPERATING ENGINEER CLASSIFICATIONS

GROUP 1 - Air Compressor on Steel Erection; Barrier Moving Machine; Boiler Operator on Compressor or Generator when mounted on a Rig; Cableway; Combination Concrete Mixer & Tower; Concrete Plant (over 4 yd. Capacity); Concrete Pump; Crane (All Types, Including Boom Truck, Cherry Picker); Crane-Compact, Track or Rubber over 4,000 lbs. capacity; Cranes-Self Erecting, Stationary, Track or Truck (All Configurations); Derrick; Dragline; Dredge (Dipper, Clam or Suction); Elevating Grader or Euclid Loader; Floating Equipment (All Types); Gradall; Helicopter Crew (Operator-Hoist or Winch); Hoe (all types); Hoisting Engine on Shaft or Tunnel Work; Hydraulic Gantry (Lifting System); Industrial-Type Tractor; Jet Engine Dryer (D8 or D9) Diesel Tractor; Locomotive (Standard Gauge); Maintenance Operator Class A; Mixer, Paving (Single or Double Drum); Mucking Machine; Multiple Scraper;

Piledriving Machine (All Types); Power Shovel; Prentice Loader; Quad 9 (Double Pusher); Rail Tamper (with auto lifting & aligning device); Refrigerating Machine (Freezer Operation); Rotary Drill, on Caisson work; Rough Terrain Fork Lift with Winch/Hoist; Side-Boom; Slip-Form Paver; Tower Derrick; Tree Shredder; Trench Machine (Over 24"" wide); Truck Mounted Concrete Pump; Tug Boat; Tunnel Machine and/or Mining Machine; and Wheel Excavator.

GROUP 2 - Asphalt Paver; Automatic Subgrader Machine, Self-Propelled (CMI Type); Bobcat Type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Boring Machine More than 48""; Bulldozer; Endloader; Hydro Milling Machine; Horizontal Directional Drill (over 50,000 ft. lbs. thrust);Kolman-type Loader (production type-Dirt); Lead Greaseman; Lighting & Traffic Signal Installation Equipment (includes all groups or classifications); Material Transfer Equipment (Shuttle Buggy) Asphalt; Pettibone-Rail Equipment; Power Grader; Power Scraper; Push Cat; Rotomill (all), Grinders & Planers of All types; Trench Machine (24"" wide & under); and Vermeer type Concrete Saw.

GROUP 3 - A-Frame; Air Compressor on Tunnel Work (low pressure); Asphalt Plant Engineer; Bobcat-type and/or Skid Steer Loader with or without Attachments; Highway Drills (all types); Locomotive (narrow gauge); Material Hoist/Elevator; Mixer, Concrete (more than one bag capacity); Mixer, one bag capacity (Side Loader); Power Boiler (Over 15 lbs. Pressure) Pump Operator installing & operating Well Points; Pump (4"" & over discharge); Railroad Tie Inserter/Remover; Roller, Asphalt; Rotovator (lime soil stabilizer); Switch & Tie Tampers (without lifting & aligning device); Utility Operator (Small equipment); and Welding Machines; Artiaculating/straight bed end dumps if assigned (minus $4.00 per hour.

GROUP 4 - Backfiller; Ballast Re-locator; Bars, Joint & Mesh Installing Machine; Batch Plant; Boring Machine Operator (48"" or less); Bull Floats; Burlap & Curing Machine; Concrete Plant (capacity 4 yd. & under); Concrete Saw (Multiple); Conveyor (Highway); Crusher; Deckhand; Farm-type Tractor with attachments (highway); Finishing Machine; Fireperson, Floating Equipment (all types); Fork Lift; Form Trencher; Hydro Hammer expect masonary; Hydro Seeder; Pavement Breaker; Plant Mixer; Post Driver; Post Hole Digger (Power Auger); Power Brush Burner; Power Form Handling Equipment; Road Widening Trencher; Roller (Brick, Grade & Macadam); Self-Propelled Power Spreader; Self-Propelled Power Subgrader; Steam Fireperson; Tractor (Pulling Sheepfoot, Roller or Grader); and Vibratory

Compactor with Integral Power.

GROUP 5 - Compressor (Portable, Sewer, Heavy & Highway); Drum Fireperson (Asphalt Plant); Generator; Masonary Forklift; Inboard-Outboard Motor Boat Launch; Oil Heater (asphalt plant); Oiler/Helper; Power Driven Heater; Power Sweeper & Scrubber; Pump (under 4"" discharge); Signalperson; Tire Repairperson; VAC/ALLS; Cranes - Compact, track or rubber under 4,000 pound capacity; fueling and greasing; and Chainmen.

GROUP 6 - Master Mechanic & Boom from 150 to 180.

GROUP 7 - Boom from 180 and over.

ENGI0066-023 06/01/2017

COLUMBIANA, MAHONING & TRUMBULL COUNTIES

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 1 - A & B	$ 39.23	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 2 - A & B	$ 38.90	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 3 - A & B	$ 34.64	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 4 - A & B	$ 30.70	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 5 - A & B	$ 27.30	19.66
HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 1 - C & D	$ 35.96	19.66
HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 2 - C & D	$ 35.66	19.66
HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 3 - C & D	$ 31.76	19.66
HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 4 - C & D	$ 28.14	19.66

HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 5 - C & D.....	$ 25.03	19.66
ALL OTHER WORK		
GROUP 1.....	$ 32.69	19.66
ALL OTHER WORK		
GROUP 2.....	$ 32.42	19.66
ALL OTHER WORK		
GROUP 3.....	$ 28.87	19.66
ALL OTHER WORK		
GROUP 4.....	$ 25.58	19.66
ALL OTHER WORK		
GROUP 5.....	$ 22.75	19.66

GROUP 1 - Rig, Pile Driver or Caisson Type; & Rig, Pile Hydraulic Unit Attached

GROUP 2 - Asphalt Heater Planer; Backfiller with Drag Attachment; Backhoe; Backhoe with Shear attached; Backhoe-Rear Pivotal Swing; Batch Plant-Central Mix Concrete; Batch Plant, Portable concrete; Berm Builder-Automatic; Boat Derrick; Boat-Tug; Boring Machine Attached to Tractor; Bullclam; Bulldozer; C.M.I. Road Builder & Similar Type; Cable Placer & Layer; Carrier-Straddle; Carryall-Scraper or Scoop; Chicago Boom; Compactor with Blade Attached; Concrete Saw (Vermeer or similar type); Concrete Spreader Finisher; Combination, Bidwell Machine; Crane; Crane-Electric Overhead; Crane-Rough Terrain; Crane-Side Boom; Crane-Truck; Crane-Tower; Derrick-Boom; Derrick-Car; Digger-Wheel (Not trencher or road widener); Double Nine; Drag Line; Dredge; Drill-Kenny or Similar Type; Easy Pour Median Barrier Machine (or similar type); Electromatic; Frankie Pile; Gradall; Grader; Gurry; Self-Propelled; Heavy Equipment Robotics Operator/Mechanic; Hoist-Monorail; Hoist-Stationary & Mobile Tractor; Hoist, 2 or 3 drum; Horizontal Directional Drill Operator; Jackall; Jumbo Machine; Kocal & Kuhlman; Land-Seagoing Vehicle; Loader, Elevating; Loader, Front End; Loader, Skid Steer; Locomotive; Mechanic/Welder; Metro Chip Harvester with Boom; Mucking Machine; Paver-Asphalt Finishing Machine; Paver-Road Concrete; Paver-Slip Form (C.M.I. or similar); Place Crete Machine with Boom; Post Driver (Carrier mounted); Power Driven Hydraulic Pump & Jack (When used in Slip Form or Lift Slab Construction); Pump Crete Machine; Regulator-Ballast; Hydraulic Power Unit not attached to Rig for Pile Drillings; Rigs-Drilling; Roto Mill or similar Full Lane (8' Wide & Over); Roto Mill or similar type (Under 8'); Shovel; Slip Form Curb Machine; Speedwing; Spikemaster; Stonecrusher; Tie Puller & Loader; Tie Tamper;

Tractor-Double Boom; Tractor with Attachments; Truck-Boom; Truck-Tire; Trench Machine; Tunnel Machine (Mark 21 Java or similar); & Whirley (or similar type)

GROUP 3 - Asphalt Plant; Bending Machine (Pipeline or similar type); Boring machine, Motor Driven; Chip Harvester without Boom; Cleaning Machine, Pipeline Type; Coating Machine, Pipeline Type; Compactor; Concrete Belt Placer; Concrete Finisher; Concrete Planer or Asphalt; Concrete Spreader; Elevator; Fork Lift (Home building only); Fork lift & Lulls; Fork Lift Walk Behind (Hoisting over 1 buck high); Form Line Machine; Grease Truck operator; Grout Pump; Gunnite Machine; Horizontal Directional Drill Locator; Single Drum Hoist with or without Tower; Huck Bolting Machine; Hydraulic Scaffold (Hoisting building materials); Paving Breaker (Self-propelled or Ridden); Pipe Dream; Pot Fireperson (Power Agitated); Refrigeration Plant; Road Widener; Roller; Sasgen Derrick; Seeding Machine; Soil Stabilizer (Pump type); Spray Cure Machine, Self-Propelled; Straw Blower Machine; Sub-Grader; Tube Finisher or Broom C.M.I. or similar type; & Tugger Hoist

GROUP 4 - Air Curtain Destructor & Similar Type; Batch Plant-Job Related; Boiler Operator; Compressor; Conveyor; Curb Builder, self-propelled; Drill Wagon; Generator Set; Generator-Steam; Heater-Portable Power; Hydraulic Manipulator Crane; Jack-Hydraulic Power driven; Jack-Hydraulic (Railroad); Ladavator; Minor Machine Operator; Mixer-Concrete; Mulching Machine; Pin Puller; Power Broom; Pulverizer; Pump; Road Finishing Machine (Pull Type); Saw-Concrete-Self-Propelled (Highway Work); Signal Person; Spray Cure Machine-Motor Powered; Stump Cutter; Tractor; Trencher Form; Water Blaster; Steam Jenny; Syphon; Vibrator-Gasoline; & Welding Machine

GROUP 5 - Brakeperson; Fireperson; & Oiler

IRON0017-002 05/01/2021

ASHTABULA (North of Route 6, starting at the Geauga County Line, proceeding east to State Route 45), CUYAHOGA, ERIE (Eastern 2/3), GEAUGA, HURON (East of a line drawn from the north border through Monroeville & Willard), LAKE, LORAIN, MEDINA (North of Old Rte. #224), PORTAGE (West of a line from Middlefield to Shalersville to Deerfield), and SUMMIT (North of Old Rte. #224, including city limits of Barberton) COUNTIES

	Rates	Fringes

IRONWORKER
Ornamental, Reinforcing, &
Structural.....$ 38.03 24.72

IRON0017-010 05/01/2021

ASHTABULA (Eastern part from Lake Erie on the north to route #322 on the south to include Conneaut, Kingsville, Sheffield, Denmark, Dorset, Cherry Valley, Wayne, Monroe, Pierpont, Richmond, Andover & Williamsfield Townships)

	Rates	Fringes
IRONWORKER		
Structural, including metal building erection & Reinforcing	$ 38.03	24.72

IRON0044-001 06/01/2021

ADAMS (Western Part), BROWN, BUTLER (Southern Part), CLERMONT, CLINTON (South of a line drawn from Blanchester to Lynchburg), HAMILTON, HIGHLAND (Excluding eastern one-fifth & portion of county inside lines drawn from Marshall to Lynchburg from the northern county line through E. Monroe to Marshall) and WARREN (South of a line drawn from Blanchester through Morrow to the west county line) COUNTIES

	Rates	Fringes
IRONWORKER, REINFORCING	$ 31.32	21.00
Beyond 30-mile radius of Hamilton County Courthouse	$ 28.67	21.20
Up to & including 30-mile radius of Hamilton County Courthouse	$ 27.60	20.70

IRON0044-002 06/01/2021

CLINTON (South of a line drawn from Blanchester to Lynchburg), HAMILTON, HIGHLAND (Excluding eastern one-fifth & portion of county inside lines drawn from Marshall to Lynchburg from the northern county line through E. Monroe to Marshall) & WARREN (South of a line drawn from Blanchester through Morrow to the west county line)

	Rates	Fringes
IRONWORKER		
Fence Erector	$ 29.75	21.00
Ornamental; Structural	$ 31.32	21.00

IRON0055-003 07/01/2021

CRAWFORD (Area Between lines drawn from where Hwy #598 & #30 meet through N. Liberty to the northern border & from said Hwy junction point due west to the border), DEFIANCE (S. of a line drawn from where Rte. #66 meets the northern line through Independence to the eastern county border), ERIE (Western 1/3), FULTON, HANCOCK, HARDIN (North of a line drawn from Maysville to a point 4 miles south of the northern line on the eastern line), HENRY, HURON (West of a line drawn from the northern border through Monroeville & Willard), LUCAS, OTTAWA, PUTNAM (East of a line drawn from the northern border down through Miller City to where #696 meets the southern border), SANDUSKY, SENECA, WILLIAMS (East of a line drawn from Pioneer through Stryker to the southern border), WOOD & WYANDOT (North of Rte. #30)

	Rates	Fringes
IRONWORKER		
Fence Erector	$ 21.30	20.92
Flat Road Mesh	$ 29.77	21.30
Tunnels & Caissons Under Pressure	$ 29.77	21.30
All Other Work	$ 31.25	26.90

IRON0147-002 06/01/2021

ALLEN (Northern half), DEFIANCE (Northern part, excluding south of a line drawn from where Rte. #66 meets the northern line through Independence to the eastern county border), MERCER (Northern half), PAULDING, PUTNAM (Western part, excluding east of a line drawn from the northern border down through Miller City to where #696 meets the southern border), VAN WERT, and WILLIAMS (Western part, excluding east of a line drawn from Pioneer through Stryker to the southern border) COUNTIES

	Rates	Fringes
IRONWORKER	$ 30.35	23.40

IRON0172-002 06/01/2021

CHAMPAIGN (Eastern one-third), CLARK (Eastern one-fourth), COSHOCTON (West of a line beginning at the northwestern county line going through Walhonding & Tunnel Hill to the southern county line), CRAWFORD (South of Rte. #30), DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, HARDIN (Excluding a line drawn from Roundhead to Maysville), HIGHLAND (Eastern one-fifth), HOCKING, JACKSON (Northern half), KNOX, LICKING, LOGAN (Eastern one-third), MADISON, MARION, MORROW, MUSKINGUM (West of a line starting at Adams Mill going to Adamsville & going from Adamsville through Blue Rock to the southern border), PERRY, PICKAWAY, PIKE (Northern half), ROSS, UNION, VINTON and WYANDOT (South of Rte. #30) COUNTIES

	Rates	Fringes
IRONWORKER	$ 32.00	21.00

IRON0207-004 06/01/2021

ASHTABULA (Southern part starting at the Geauga County line), COLUMBIANA (E. of a line from Damascus to Highlandtown), MAHONING (N. of Old Route #224), PORTAGE (E. of a line from Middlefield to Shalersville to Deerfield) & TRUMBULL

	Rates	Fringes
IRONWORKER		
Layout; Sheeter	$ 32.07	26.00
Ornamental; Reinforcing; Structural	$ 31.07	26.00
Ornamental; Reinforcing	$ 29.72	25.18

IRON0290-002 06/01/2021

ALLEN (Southern half), AUGLAIZE, BUTLER (North of a line drawn from east to the west county line going through Oxford, Darrtown & Woodsdale), CHAMPAIGN (Excluding east of a line drawn from Catawla to the point where #68 intersects the northern county line), CLARK (Western two-thirds), CLINTON (Excluding south of a line drawn from Blanchester to Lynchburg), DARKE, GREENE, HIGHLAND (Inside lines drawn from Marshall to Lynchburg & from the northern county line through East Monroe to Marshall), LOGAN (West of a line drawn from West Liberty to where the northern county line meets the western county line of Hardin), MERCER (Southern half), MIAMI, MONTGOMERY, PREBLE, SHELBY & WARREN (Excluding south of a line drawn from Blanchester through Morrow to the western county

line) COUNTIES

	Rates	Fringes
IRONWORKER	$ 30.99	23.10

IRON0549-003 12/01/2021

BELMONT, GUERNSEY, HARRISON, JEFFERSON, MONROE & MUSKINGUM (Excluding portion west of a line starting at Adams Mill going to Adamsville and going from Adamsville through Blue Rock to the south border)

	Rates	Fringes
IRONWORKER	$ 34.44	18.77

IRON0550-004 05/01/2021

ASHLAND, CARROLL, COLUMBIANA (W. of a line from Damascus to Highlandtown), COSHOCTON (E. of a line beginning at NW Co. line going through Walhonding & Tunnel Hill to the South Co. line), HOLMES, HURON (S. of Old Rte. #224), MAHONING (S. of Old Rte. #224), MEDINA (S. of Old Rte. #224), PORTAGE (S. of Old Rte. #224), RICHLAND, STARK, SUMMIT (S. of Old Rte. #224, Excluding city limits of Barberton), TUSCARAWAS, & WAYNE

	Rates	Fringes
Ironworkers:Structural, Ornamental and Reinforcing	$ 30.17	21.08

IRON0769-004 06/01/2021

ADAMS (Eastern Half), GALLIA, JACKSON (Southern Half), LAWRENCE & SCIOTO

	Rates	Fringes
IRONWORKER	$ 33.00	27.29

IRON0787-003 06/01/2021

ATHENS, MEIGS, MORGAN, NOBLE, and WASHINGTON COUNTIES

	Rates	Fringes

IRONWORKER.....$ 31.94 23.05

LAB00265-008 05/01/2021

	Rates	Fringes
LABORER		
ASHTABULA, ERIE, HURON, LORAIN, LUCAS, MAHONING, MEDINA, OTTAWA, PORTAGE, SANDUSKY, STARK, SUMMIT, TRUMBULL & WOOD COUNTIES		
GROUP 1	$ 33.70	11.85
GROUP 2	$ 33.87	11.85
GROUP 3	$ 34.20	11.85
GROUP 4	$ 34.65	11.85
CUYAHOGA AND GEAUGA COUNTIES ONLY: SEWAGE PLANTS, WASTE PLANTS, WATER TREATMENT FACILITIES, PUMPING STATIONS, & ETHANOL PLANTS		
CONSTRUCTION	$ 34.93	11.85
CUYAHOGA, GEAUGA & LAKE COUNTIES		
GROUP 1	$ 34.93	11.85
GROUP 2	$ 35.10	11.85
GROUP 3	$ 35.43	11.85
GROUP 4	$ 35.88	11.85
REMAINING COUNTIES OF OHIO		
GROUP 1	$ 33.27	11.85
GROUP 2	$ 33.44	11.85
GROUP 3	$ 33.77	11.85
GROUP 4	$ 35.88	11.85

LABORER CLASSIFICATIONS

GROUP 1 - Asphalt Laborer; Carpenter Tender; Concrete Curing Applicator; Dump Man (Batch Truck); Guardrail and Fence Installer; Joint Setter; Laborer (Construction); Landscape Laborer; Mesh Handlers & Placer; Right-of-way Laborer; Riprap Laborer & Grouter; Scaffold Erector; Seal Coating; Surface Treatment or Road Mix Laborer; Sign Installer; Slurry Seal; Utility Man; Bridge Man; Handyman; Waterproofing Laborer; Flagperson; Hazardous Waste (level D); Diver Tender; Zone Person & Traffic Control

GROUP 2 - Asphalt Raker; Concrete Puddler; Kettle Man Pipeline); Machine Driven Tools (Gas, Electric, Air); Mason

Tender; Brick Paver; Mortar Mixer; Power Buggy or Power Wheelbarrow; Paint Striper; Sheeting & Shoring Man; Surface Grinder Man; Plastic Fusing Machine Operator; Pug Mill Operator; & Vacuum Devices (wet or dry); Rodding Machine Operator; Diver; Screwman or Paver; Screed Person; Water Blast, Hand Held Wand; Pumps 4"" & Under (Gas, Air or Electric) & Hazardous Waste (level C); Air Track and Wagon Drill; Bottom Person; Cofferdam (below 25 ft. deep); Concrete Saw Person; Cutting with Burning Torch; Form Setter; Hand Spiker (Railroad); Pipelayer; Tunnel Laborer (without air) & Caisson; Underground Person (working in Sewer and Waterline, Cleaning, Repairing & Reconditioning); Sandblaster Nozzle Person; & Hazardous Waste (level B)

GROUP 3 - Blaster; Mucker; Powder Person; Top Lander; Wrencher (Mechanical Joints & Utility Pipeline); Yarner; Hazardous Waste (level A); Concrete Specialist; Concrete Crew in Tunnels (With Air-pressurized - $1.00 premium); Curb Setter & Cutter; Grade Checker; Utility Pipeline Tapper; Waterline; and Caulker

GROUP 4 - Miner (With Air-pressurized - $1.00 premium); & Gunite Nozzle Person

TUNNEL LABORER WITH AIR-PRESSURIZED ADD $1.00 TO BASE RATE

SIGNAL PERSON WILL RECEIVE THE RATE EQUAL TO THE RATE PAID THE LABORER CLASSIFICATION FOR WHICH HE OR SHE IS SIGNALING.

PAIN0006-002 05/01/2018

ASHTABULA, CUYAHOGA, GEAUGA, LAKE, LORAIN, PORTAGE (N. of the East-West Turnpike) & SUMMIT (N. of the East-West Turnpike)

	Rates	Fringes
PAINTER		
COMMERCIAL NEW WORK; REMODELING; & RENOVATIONS		
GROUP 1	$ 27.90	16.16
GROUP 2	$ 28.30	16.16
GROUP 3	$ 28.60	16.16
GROUP 4	$ 34.16	16.16
COMMERCIAL REPAINT		
GROUP 1	$ 26.40	16.16
GROUP 2	$ 26.80	16.16
GROUP 3	$ 27.10	16.16

PAINTER CLASSIFICATIONS - COMMERCIAL NEW WORK; REMODELING; & RENOVATIONS

GROUP 1 - Brush; & Roller

GROUP 2 - Sandblasting & Buffing

GROUP 3 - Spray Painting; Closed Steel Above 55 feet; Bridges & Open Structural Steel; Tanks - Water Towers; Bridge Painters; Bridge Riggers; Containment Builders

GROUP 4 - Bridge Blaster

PAINTER CLASSIFICATIONS - COMMERCIAL REPAINT

GROUP 1 - Brush; & Roller

GROUP 2 - Sandblasting & Buffing

GROUP 3 - Spray Painting

PAIN0007-002 07/01/2021

FULTON, HENRY, LUCAS, OTTAWA (Excluding Allen, Bay, Bono, Catawba Island, Clay Center, Curtice, Danbury, Eagle Beach, Elliston, Elmore, Erie, Fishback, Gem Beach & Genova) & WOOD

	Rates	Fringes
PAINTER		
NEW COMMERCIAL WORK		
GROUP 1	$ 28.74	18.77
GROUP 2	$ 28.74	18.77
GROUP 3	$ 28.74	18.77
GROUP 4	$ 28.74	18.77
GROUP 5	$ 28.74	18.77
GROUP 6	$ 28.74	18.77
GROUP 7	$ 28.74	18.77
GROUP 8	$ 28.74	18.77
GROUP 9	$ 28.74	18.77

REPAINT IS 90% OF JR

PAINTER CLASSIFICATIONS

GROUP 1 - Brush; Spray & Sandblasting Pot Tender

GROUP 2 - Refineries & Refinery Tanks; Surfaces 30 ft. or

over where material is applied to or labor performed on above ground level (exterior), floor level (interior)

GROUP 3 - Swing Stage & Chair

GROUP 4 - Lead Abatement

GROUP 5 - All Methods of Spray

GROUP 6 - Solvent-Based Catalized Epoxy Materials of 2 or More Component Materials, to include Solvent-Based Conversion Varnish (excluding water based)

GROUP 7 - Spray Solvent Based Material; Sand & Abrasive Blasting

GROUP 8 - Towers; Tanks; Bridges; Stacks Over 30 Feet

GROUP 9 - Epoxy Spray (excluding water based)

PAIN0012-008 05/01/2019

BUTLER COUNTY

	Rates	Fringes
PAINTER		
GROUP 1	$ 21.95	10.20
GROUP 2	$ 25.30	10.20
GROUP 3	$ 25.80	10.20
GROUP 4	$ 26.05	10.20
GROUP 5	$ 26.30	10.20

PAINTER CLASSIFICATIONS

GROUP 1: Bridge Equipment Tender; Bridge/Containment Builder

GROUP 2: Brush & Roller

GROUP 3: Spray

GROUP 4: Sandblasting; & Waterblasting

GROUP 5: Elevated Tanks; Steeplejack Work; Bridge; & Lead Abatement

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PAIN0012-010 05/01/2019

BROWN, CLERMONT, CLINTON, HAMILTON & WARREN

	Rates	Fringes
PAINTER		
HEAVY & HIGHWAY BRIDGES-GUARDRAILS-LIGHTPOLES-STRIPING		
Bridge Equipment Tender and Containment Builder	$ 21.95	10.20
Bridges when highest point of clearance is 60 feet or more; & Lead Abatement Projects	$ 26.30	10.20
Brush & Roller	$ 25.30	10.20
Sandblasting & Hopper Tender; Water Blasting	$ 26.05	10.20
Spray	$ 25.80	10.20

PAIN0093-001 12/01/2018

ATHENS, GUERNSEY, HOCKING, MONROE, MORGAN, NOBLE and WASHINGTON COUNTIES

	Rates	Fringes
PAINTER		
Bridges; Locks; Dams; Tension Towers; & Energized Substations	$ 34.04	18.50
Power Generating Facilities.	$ 30.89	18.50

PAIN0249-002 06/01/2020

CLARK, DARKE, GREENE, MIAMI, MONTGOMERY & PREBLE

	Rates	Fringes
PAINTER		
GROUP 1 - Brush & Roller	$ 24.17	11.22
GROUP 2 - Swing, Scaffold Bridges; Structural Steel; Open Acid Tank; High Tension Electrical Equipment; & Hot Pipes	$ 24.17	11.22
GROUP 3 - Spray; Sandblast; Steamclean; Lead Abatement	$ 24.92	11.22

GROUP 4 - Steeplejack Work	$ 25.12	11.22
GROUP 5 - Coal Tar	$ 25.67	11.22
GROUP 6 - Bridge Equipment Tender & or Containment Builder	$ 32.88	11.22
GROUP 7 - Tanks, Stacks & Towers	$ 27.81	11.22
GROUP 8 - Bridge Blaster, Rigger	$ 35.88	11.22

PAIN0356-002 09/01/2009

KNOX, LICKING, MUSKINGUM, and PERRY

	Rates	Fringes
PAINTER		
Bridge Equipment Tenders and Containment Builders	$ 27.93	7.25
Bridges; Blasters; andRiggers	$ 34.60	7.25
Brush and Roller	$ 20.93	7.25
Sandblasting; Steam Cleaning; Waterblasting; and Hazardous Work	$ 25.82	7.25
Spray	$ 21.40	7.25
Structural Steel and Swing Stage	$ 25.42	7.25
Tanks; Stacks; and Towers	$ 28.63	7.25

PAIN0438-002 12/01/2021

BELMONT, HARRISON and JEFFERSON COUNTIES

	Rates	Fringes
PAINTER		
Bridges, Locks, Dams, Tension Towers & Energized Substations	$ 34.47	20.60
Power Generating Facilities	$ 29.65	17.68

PAIN0476-001 06/01/2021

COLUMBIANA, MAHONING, and TRUMBULL COUNITES

	Rates	Fringes
PAINTER		
GROUP 1	$ 25.79	15.81

GROUP 2	$ 33.10	15.81
GROUP 3	$ 26.00	15.81
GROUP 4	$ 27.12	15.81
GROUP 5	$ 27.79	15.81
GROUP 6	$ 26.69	15.81
GROUP 7	$ 27.79	15.81

PAINTER CLASSIFICATIONS:

GROUP 1: Painters, Brush & Roller

GROUP 2: Bridges

GROUP 3: Structural Steel

GROUP 4: Spray, Except Bar Joist/Deck

GROUP 5: Epoxy/Mastic; Spray- Bar Joist/Deck; Working Above 50 Feet; and Swingstages

GROUP 6: Tanks; Sandblasting

GROUP 7: Towers; Stacks

PAIN0555-002 06/01/2021

ADAMS, HIGHLAND, JACKSON, PIKE & SCIOTO

	Rates	Fringes
PAINTER		
GROUP 1	$ 31.95	17.05
GROUP 2	$ 33.47	17.05
GROUP 3	$ 34.99	17.05
GROUP 4	$ 37.97	17.05

PAINTER CLASSIFICATIONS

GROUP 1 - Containment Builder

GROUP 2 - Brush; Roller; Power Tools, Under 40 feet

GROUP 3 - Sand Blasting; Spray; Steam Cleaning; Pressure Washing; Epoxy & Two Component Materials; Lead Abatement; Hazardous Waste; Toxic Materials; Bulk & Storage Tanks of 25,000 Gallon Capacity or More; Elevated Tanks

GROUP 4 - Stacks; Bridges

PAIN0639-001 05/01/2011

	Rates	Fringes
Sign Painter & Erector	$ 20.61	3.50+a+b+c

FOOTNOTES: a. 7 Paid Holidays: New Year's Day; Memorial Day; July 4th; Labor Day; Thanksgiving Day; Christmas Day & 1 Floating Day
b. Vacation Pay: After 1 year's service - 5 days' paid vacation; After 2, but less than 10 years' service - 10 days' paid vacation; After 10, but less than 20 years' service - 15 days' paid vacation; After 20 years' service - 20 days' paid vacation
c. Funeral leave up to 3 days maximum paid leave for death of mother, father, brother, sister, spouse, child, mother-in-law, father-in-law, grandparent and inlaw provided employee attends funeral

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PAIN0788-002 06/01/2020

ASHLAND, CRAWFORD, ERIE, HANCOCK, HURON, MARION, MORROW, OTTAWA (Allen, Bay, Bono, Catawba Island, Clay Center, Curtice, Danbury, Eagle Beach, Elliston, Elmore, Erie, Fishback, Gem Beach & Genoa), RICHLAND, SANDUSKY, SENECA & WYANDOT

	Rates	Fringes
PAINTER		
Brush & Roller	$ 24.66	14.05
Structural Steel	$ 26.26	14.05

WINTER REPAINT: Between December 1 to March 31 - 90%JR

$.50 PER HOUR SHALL BE ADDED TO THE RATE OF PAY FOR THE CLASSIFICATION OF WORK:

While working swingstage, boatswain chair, needle beam and horizontal cable. While operating sprayguns, sandblasting, cobblasting and high pressure waterblasting (4000psi).

$1.00 PER HOUR SHALL BE ADDED TO THE RATE OF PAY FOR THE CLASSIFICATION OF WORK:

For the application of catalized epoxy, including latex epoxy that is deemed hazardous, lead abatement, or for work or material where special precautions beyond normal work

duties must be taken. For working on stacks, tanks, and towers over 40 feet in height.

PAIN0813-005 12/01/2008

GALLIA, LAWRENCE, MEIGS & VINTON

	Rates	Fringes
PAINTER		
Base Rate	$ 24.83	10.00
Bridges, Locks, Dams & Tension Towers	$ 27.83	10.00

PAIN0841-001 06/01/2018

MEDINA, PORTAGE (South of and including Ohio Turnpike), and SUMMIT (South of and including Ohio Turnpike) COUNTIES

	Rates	Fringes
Painters:		
GROUP 1	$ 25.75	14.35
GROUP 2	$ 26.40	14.35
GROUP 3	$ 26.50	14.35
GROUP 4	$ 26.60	14.35
GROUP 5	$ 27.00	14.35
GROUP 6	$ 39.20	11.75
GROUP 7	$ 27.00	14.35

PAINTER CLASSIFICATIONS:

GROUP 1 - Brush, Roller & Paperhanger

GROUP 2 - Epoxy Application

GROUP 3 - Swing Scaffold, Bosum Chair, & Window Jack

GROUP 4 - Spray Gun Operator of Any & All Coatings

GROUP 5 - Sandblast, Painting of Standpipes, etc. from Scaffolds, Bridge Work and/or Open Structural Steel, Standpipes and/or Water Towers

GROUP 6 - Public & Commerce Transportation, Steel or Galvanized, Bridges, Tunnels & Related Support Items (concrete)

GROUP 7 - Synthetic Exterior, Drywall Finisher and/or Taper, Drywall Finisher and Follow-up Man Using Automatic Tools

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PAIN0841-002 06/01/2018

CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS & WAYNE

	Rates	Fringes
PAINTER		
Bridges; Towers, Poles & Stacks; Sandblasting Steel; Structural Steel & Metalizing	$ 22.78	13.63
Brush & Roller	$ 21.77	13.63
Spray; Tank Interior & Exterior	$ 22.60	13.63

PAIN1020-002 07/01/2020

ALLEN, AUGLAIZE, CHAMPAIGN, DEFIANCE, HARDIN, LOGAN, MERCER, PAULDING, PUTNAM, SHELBY, VAN WERT, and WILLIAMS COUNTIES

	Rates	Fringes
PAINTER		
Brush & Roller	$ 25.22	14.11
Drywall Finishing & Taping	$ 23.92	14.11
Lead Abatement	$ 26.97	14.11
Spray, Sandblasting Pressure Cleaning, & Refinery	$ 25.87	14.11
Swing Stage, Chair, Spiders, & Cherry Pickers	$ 25.47	14.11
Wallcoverings	$ 22.82	14.11

All surfaces 40 ft. or over where material is applied to or labor performed on, above ground level (exterior), floor level (interior) - $.50 premium

Applying Coal Tar Products - $1.00 premium

PAIN1275-002 06/01/2020

DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, MADISON, PICKAWAY, ROSS & UNION

	Rates	Fringes
PAINTER		
Bridges	$ 34.64	14.40
Brush; Roller	$ 25.16	14.40
Sandblasting; Steamcleaning; Waterblasting (3500 PSI or Over)& Hazardous Work	$ 25.86	14.40
Spray	$ 25.66	14.40
Stacks; Tanks; & Towers	$ 28.67	14.40
Structural Steel & Swing Stage	$ 25.46	14.40

PLAS0109-001 05/01/2018

MEDINA, PORTAGE, STARK, and SUMMIT COUNTIES

	Rates	Fringes
PLASTERER	$ 28.86	17.11

PLAS0109-003 05/01/2018

CARROLL, HOLMES, TUSCARAWAS, and WAYNE COUNTIES

	Rates	Fringes
PLASTERER	$ 28.21	17.11

PLAS0132-002 05/01/2018

BROWN, BUTLER, CLERMONT, HAMILTON, HIGHLAND, WARREN COUNTIES

	Rates	Fringes
PLASTERER	$ 28.86	17.11

PLAS0404-002 05/01/2018

ASHTABULA, CUYAHOGA, GEAUGA, AND LAKE COUNTIES

	Rates	Fringes
PLASTERER	$ 29.63	17.11

PLAS0404-003 05/01/2018

LORAIN COUNTY

	Rates	Fringes
PLASTERER	$ 28.86	17.11

PLAS0526-022 05/01/2018

COLUMBIANA, MAHONING, and TRUMBULL COUNTIES

	Rates	Fringes
PLASTERER	$ 28.86	17.11

PLAS0526-023 05/01/2018

BELMONT, HARRISON, and JEFFERSON COUNTIES

	Rates	Fringes
PLASTERER	$ 28.21	17.11

PLAS0886-001 05/01/2018

FULTON, HANCOCK, HENRY, LUCAS, PUTNAM, and WOOD COUNTIES

	Rates	Fringes
PLASTERER	$ 29.63	17.11

PLAS0886-003 05/01/2018

DEFIANCE, ERIE, HURON, OTTAWA, PAULDING, SANDUSKY, and SENECA COUNTIES

	Rates	Fringes
PLASTERER	$ 28.86	17.11

PLAS0886-004 05/01/2018

ALLEN, AUGLAIZE, HARDIN, LOGAN, MERCER, and VAN WERT COUNTIES

	Rates	Fringes
PLASTERER	$ 28.21	17.11

PLUM0042-002 07/01/2020

ASHLAND, CRAWFORD, ERIE, HURON, KNOX, LORAIN, MORROW, RICHLAND

& WYANDOT

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 34.82	24.67

PLUM0050-002 07/06/2020

DEFIANCE, FULTON, HANCOCK, HENRY, LUCAS, OTTAWA, PAULDING, PUTNAM, SANDUSKY, SENECA, WILLIAMS & WOOD

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 43.60	26.73

PLUM0055-003 05/04/2021

ASHTABULA, CUYAHOGA, GEAUGA, LAKE, MEDINA (N. of Rte. #18 & Smith Road) & SUMMIT (N. of Rte. #303, including the corporate limits of the city of Hudson)

	Rates	Fringes
PLUMBER	$ 38.47	28.07

PLUM0083-001 07/01/2017

BELMONT & MONROE (North of Rte. #78)

	Rates	Fringes
Plumber and Steamfitter	$ 32.16	31.51

PLUM0094-002 05/01/2020

CARROLL (Northen Half), STARK, and WAYNE COUNTIES

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 35.78	21.44

PLUM0120-002 05/03/2021

ASHTABULA, CUYAHOGA, GEAUGA, LAKE, LORAIN (the C.E.I. Power House in Avon Lake), MEDINA (N. of Rte. #18) & SUMMIT (N. of

#303)

	Rates	Fringes
PIPEFITTER.....	$ 41.72	26.30

PLUM0162-002 06/01/2021

CHAMPAIGN, CLARK, CLINTON, DARKE, FAYETTE, GREENE, MIAMI, MONTGOMERY & PREBLE

	Rates	Fringes
Plumber, Pipefitter, Steamfitter.....	$ 33.40	27.09

PLUM0168-002 06/01/2021

MEIGS, MONROE (South of Rte. #78), MORGAN (South of Rte. #78) & WASHINGTON

	Rates	Fringes
PLUMBER/PIPEFITTER.....	$ 37.09	33.26

PLUM0189-002 06/01/2019

DELAWARE, FAIRFIELD, FRANKLIN, HOCKING, LICKING, MADISON, MARION, PERRY, PICKAWAY, ROSS & UNION

	Rates	Fringes
Plumber, Pipefitter, Steamfitter.....	$ 38.45	16.98

PLUM0219-002 06/01/2021

MEDINA (Rte. #18 from eastern edge of Medina Co., west to eastern corporate limits of the city of Medina, & on the county road from the west corporate limits of Medina running due west to and through community of Risley to the western edge of Medina County - All territory south of this line), PORTAGE, and SUMMIT (S. of Rte. #303) COUNTIES

	Rates	Fringes

	Rates	Fringes
Plumber and Steamfitter	$ 40.42	24.66

PLUM0392-002 06/01/2021

BROWN, BUTLER, CLERMONT, HAMILTON & WARREN

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 35.21	22.99

PLUM0396-001 06/01/2021

COLUMBIANA (Excluding Washington & Yellow Creek Townships & Liverpool Twp. - Secs. 35 & 36 - West of County Road #427), MAHONING and TRUMBULL COUNTIES

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 35.35	27.01

PLUM0495-002 06/01/2018

CARROLL (Rose, Monroe, Union, Lee, Orange, Perry & Loudon Townships), COLUMBIANA (Washington & Yellow Creek Townships & Liverpool Township, Secs. 35 & 36, West of County Rd. #427), COSHOCTON, GUERNSEY, HARRISON, HOLMES, JEFFERSON, MORGAN (South to State Rte. #78 & from McConnelsville west on State Rte. #37 to the Perry County line), MUSKINGUM, NOBLE, and TUSCARAWAS COUNTIES

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 38.24	23.09

PLUM0577-002 06/01/2019

ADAMS, ATHENS, GALLIA, HIGHLAND, JACKSON, LAWRENCE, PIKE, SCIOTO & VINTON

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 34.90	24.11

PLUM0776-002 07/01/2020

ALLEN, AUGLAIZE, HARDIN, LOGAN, MERCER, SHELBY and VAN WERT COUNTIES

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 37.63	25.58

TEAM0377-003 05/01/2021

STATEWIDE, EXCEPT CUYAHOGA, GEAUGA & LAKE

	Rates	Fringes
TRUCK DRIVER		
GROUP 1	$ 29.74	15.70
GROUP 2	$ 30.16	15.70

TRUCK DRIVER CLASSIFICATIONS

GROUP 1 - Asphalt Distributor; Batch; 4- Wheel Service; 4-Wheel Dump; Oil Distributor & Tandem

GROUP 2 - Tractor-Trailer Combination: Fuel; Pole Trailer; Ready Mix; Semi-Tractor; & Asphalt Oil Spraybar Man When Operated From Cab; 5 Axles & Over; Belly Dump; End Dump; Articulated Dump; Heavy Duty Equipment; Low Boy; & Truck Mechanic

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TEAM0436-002 05/01/2021

CUYAHOGA, GEAUGA & LAKE

	Rates	Fringes
TRUCK DRIVER		
GROUP 1	$ 30.65	16.95
GROUP 2	$ 31.15	16.95

GROUP 1: Straight & Dump, Straight Fuel

GROUP 2: Semi Fuel, Semi Tractor, Euclids, Darts, Tank, Asphalt Spreaders, Low Boys, Carry-All, Tourna-Rockers, Hi-Lifts, Extra Long Trailers, Semi-Pole Trailers, Double Hook-Up Tractor Trailers including Team Track & Railroad Siding, Semi-Tractor & Tri-Axle Trailer, Tandem Tractor & Tandem Trailer, Tag Along Trailer, Expandable Trailer or

Towing Requiring Road Permits, Ready-Mix (Agitator or Non-Agitator), Bulk Concrete Driver, Dry Batch Truck, Articulated End Dump

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($15.00) or 13658 ($11.25). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local),

a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union

average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.

Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"

Table of Contents

Davis Bacon Requirements

Wage Rate Requirements

As used in these provisions "subrecipient" means the City of Canton.

(a) The following applies to any contract in excess of $2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a public building or public work, or building or work financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1.

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.wdol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The EPA award official shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to

the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the subrecipient(s) to the State award official. The State award official will transmit the report, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the questions, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions

or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the subgrant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees --

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall

be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may by appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

Contract Provision For Contracts In Excess Of $100,000 And Subject To The Overtime Provisions Of The Contract Work Hours And Safety Standards Act

The following language must be included in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These provisions are to be included in addition to the provisions for contracts in excess of $2,000. As used in these paragraphs, the terms laborers and mechanics include watchmen and guards.

(b) Contract Work Hours and Safety Standards Act. The following applies to any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. As used in these paragraphs, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

Contract Provision For Contracts In Excess Of $100,000 Subject ONLY To The Contract Work Hours And Safety Standards Act

In addition to the provisions for contracts in excess of $2,000, for any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, you must insert clauses requiring:

(c) The following applies to any contract subject only to the Contract Work Hours and Safety

Standards Act and not to any of the other statutes cited in 29 CFR 5.1.

The contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid.

The records shall be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Ohio EPA, EPA and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

Disadvantaged Business Enterprises (DBE) Utilization

(Required Contract Provision)

USEPA has a program to encourage the participation of disadvantaged businesses in the construction activities funded by the Clean Water and Drinking Water SRF's. "DBE" is an all inclusive term that includes Minority Business Enterprises (MBE), Women Business Enterprises (WBE), Small Business Enterprises (SBE), Small Business in Rural Areas (SBRA), HUBZone Small Business, Labor Surplus Area Firms (LSAF), and other entities defined as socially and/or economically disadvantaged. While the WPCLF and WSRLA strongly encourage participation by all disadvantaged groups, specific participation goals are negotiated with USEPA only for Minority Business Enterprises and Women's Business Enterprises.

Goals

As a condition of receiving capitalization grants from U.S. EPA for the Water Pollution Control Loan Fund (WPCLF) and the Water Supply Revolving Loan Account (WSRLA), the Ohio EPA negotiates "fair share" Disadvantaged Business Enterprises (DBE) objectives with U.S. EPA. The current negotiated goals for construction related activities are 1.3% of all contracts to MBEs and 1.0% of all contracts to WBEs.

DBE Certification

Under the DBE program, qualified DBE's are those that have been certified as an MBE or WBE. Certifications can be obtained from a federal agency such as the Small Business Administration or the Department of Transportation or by an approved State agency. The Unified Certification Program (UCP) administered by the Ohio Department of Transportation (ODOT) can provide the necessary DBE certifications. Information on the UCP can be found at www.ohioucp.org as well as the ODOT website www.dot.state.oh.us/divisions/equalopportunity/pages/dbe.aspx. Applications for certification by EPA can be found on EPA's Small Business Programs website at www.epa.gov/osbp under the Disadvantaged Business Enterprise Program link. Any questions regarding EPA's certification process should be directed to Teree Henderson of EPA at 202-566-2222.

DBE Qualifications

To qualify for MBE certification, businesses must be 51 percent owned and controlled by a U.S. citizen and Ohio resident belonging to an African American, Native American, Hispanic, or Asian American ethnic group. In addition, the business must be in operation for at least one year prior to submitting an application. For DBE status, a business must be at least 51 percent owned by a socially and economically disadvantaged person who participates in the daily operations of the business. This person must be a woman or of African-American, Hispanic, Native American, Asian American ethnicity.

Program Requirements

To comply with DBE program requirements the WPCLF/WSRLA loan recipient must do the following:

1. Create and maintain a bidder's list (see description below)

2. Include contract conditions applicable to the DBE program in all procurement contracts entered into by the Borrower for all WPCLF and WSRLA projects. These conditions are listed below.
3. Follow, document, and maintain documentation of good faith efforts on the part of prime contractors to ensure that Disadvantaged Business Enterprises (DBEs) have the opportunity to participate in the project.
4. Review the Form 6100-3 and 6100-4 submittals provided by bidders on the project for completeness and obtain any additional information necessary to verify the certification status of all proposed subcontractors.
5. Obtain documentation of the good faith efforts of the prime contractor if the prime contractor does not meet the MBE or WBE goal.
6. Obtain a written confirmation from any prime contractor states that they will not meet the MBE and WBE goals because they will not be entering into any agreements for goods or services with any company, firm, joint venture, or individual.
7. Submit the following to the Ohio EPA/DEFA as part of the bid package upon which the WPCLF/WSRLA loan amount is determined:
   - Form 6100-3 from each subcontractor
   - Form 6100-4 from each prime contractor
   - a copy of the Good Faith Efforts documentation from any prime contractors that will not meet the MBE and WBE goals,
   - if any of the prime contractors will not meet the MBE and WBE goals because they will not be entering into any agreements for goods or services with any company, firm, joint venture, or individual, a copy of the written confirmation from that prime contractor
8. Report MBE/WBE accomplishments on Form 5700-52A annually (within 15 days after October 1st).

NOTE: It is up to the WPCLF/WSRLA loan recipient whether or not to require completion and submission of Forms 6100-3 and 6100-4 from all bidders with the bid proposal or to accept completion and submission from the successful bidder(s) only at some time after bids are received. Regardless of whether the forms are completed and submitted with the bids or at some later time once the successful bidders are identified, completed forms are to be submitted to Ohio EPA with the bid package.

To comply with DBE program requirements all prime contractors must do the following:

1. Follow, document, and maintain documentation of their good faith efforts.
2. Complete and submit **Form 6100-4 DBE Subcontractor Utilization Summary** as part of the bid proposal package to the loan recipient.
3. Have its Disadvantaged Business Enterprise subcontractors complete **Form 6100-3 DBE Subcontractor Proposed Performance Form** and submit those as part of the bid proposal package to the loan recipient.
4. Provide **Form 6100-2 DBE Subcontractor Actual Participation Form** to all of its Disadvantaged Business Enterprise subcontractors for completion at the end of the work.
5. During construction, provide the data necessary so that the loan recipient can report MBE/WBE accomplishments on Form 5700-52A annually (within 15 days after October 1st).

Bidders List

The Borrower must create, maintain, and use a bidders list for purposes of soliciting both MBE/WBEs and non-MBE/WBEs during procurement of construction, equipment, supplies, and services. This list shall include:

1. Entity's name with point of contact;
2. Entity's mailing address, telephone number, and e-mail address;
3. The procurement on which the entity bid or quoted, and when; and
4. Entity's status as an MBE/WBE or non-MBE/WBE.

Borrowers that receive less than $250,000 or less in any one fiscal year can be exempt from maintaining a Bidders List.

The Bidders List shall be maintained until the project period has expired and the Borrower is no longer receiving EPA funding. The Bidders List must include all firms that bid on the prime contracts, or bid or gave a quote on subcontracts, including both MBE/WBEs and non-MBE/WBEs.

Required Contract Conditions

The DBE Specification language and instructions to the bidders and Forms 6100-2, 6100-3 and 6100-4 must be included in the contract documents and referenced in the Instructions to Bidders, informing bidders that the forms must be completed and submitted with their bid for all WPCLF and WSRLA projects:

1. The prime contractor must pay its subcontractor for satisfactory performance no more than 30 days from the prime contractor's receipt of payment from the owner.
2. The prime contractor must notify the owner in writing prior to the termination of any Disadvantage Business Enterprise subcontractor for convenience by the prime contractor.
3. If a Disadvantage Business Enterprise contractor fails to complete work under the subcontract for any reason, the prime contractor must employ the six Good Faith Efforts (listed below) if soliciting a replacement contractor.
4. The prime contractor must employ the six Good Faith Efforts even if the prime contractor has achieved its fair share objectives.
5. An owner must ensure that each procurement contract it awards contains the following terms and conditions:

   The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

Good Faith Efforts

Borrowers and their prime contractors must follow, document, and maintain documentation of their good faith efforts as listed below to ensure that Disadvantaged Business Enterprises (DBEs) have the opportunity to participate in the project by increasing DBE awareness of procurement efforts and outreach.

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities; including DBEs on solicitation lists and soliciting them whenever they are potential sources.
2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
3. Consider in the contracting process whether firms competing for large contracts could be subcontracted with DBEs. This will include dividing total requirements when economically feasible into smaller tasks or quantities to permit participation by DBEs in the competitive process.
4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.
5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce.
6. If the prime contractor awards subcontracts, require the prime contractor to take the steps in numbers 1 through 5 above.

DBE Forms

Form 6100-3 – Each prime contractor must have its DBE subcontractors complete **Form 6100-3 DBE Subcontractor Proposed Performance Form**. This form gives the DBE subcontractor the opportunity to report the scope and cost of the subcontract and it should be forwarded to the Prime Contractor along with the DBE's quote. Each subcontractor completes one Form 6100-3. The Borrower must submit all Form 6100-3 forms to the Ohio EPA/DEFA as part of the bid package upon which the WPCLF/WSRLA loan amount is determined.

Form 6100-4 – Each prime contractor must complete and submit **Form 6100-4 DBE Subcontractor Utilization Summary** as part of the prime contractor's bid proposal package to the Borrower. This form summarizes the Prime Contractor's intended use of identified DBE(s) and the estimated dollar amount of each subcontract. Only one Form 6100-4 form is required from each Prime Contractor. The Borrower must submit this form to the Ohio EPA/DEFA as part of the bid package upon which the WPCLF/WSRLA loan amount is determined.

Form 6100-2 - The prime contractor must provide **Form 6100-2 DBE Subcontractor Actual Participation Form** to all of its Disadvantaged Business Enterprise subcontractors.

This form gives the DBE subcontractor the opportunity to describe the work the DBE received from the Prime Contractor, how much the DBE was paid and any other concerns the DBE might have. Disadvantaged Business Enterprise subcontractors must send completed Form 6100-2 directly to the Region 5 DBE Coordinator:

Adrianne M. Callahan, Region 5 MBE/WBE Coordinator
USEPA, Acquisition and Assistance Branch
77 West Jackson Boulevard (MC-10J)
Chicago, IL 60604

This form is completed after the work by the subcontractor is done, and is NOT submitted with the bid package to Ohio EPA.

Reporting During Construction – Form 5700-52A

The purpose of MBE/WBE reporting is to monitor the grant recipient's accomplishments in utilizing MBEs and WBEs; and adherence to the good faith efforts (i.e., outreach to MBEs, WBEs, and other DBEs); and progress in achieving MBE and WBE Goals. During the progress of the construction project, the loan recipient must complete & submit Form 5700-52A annually (**within 15 days after October 1st**). If there were no MBEs or WBEs utilized, or no procurement expenditures of any kind were made during the reporting period, a "negative report" is still required.

Reports are to be sent to:

Becky McKinney Ohio EPA – DEFA
P.O. Box 1049
Columbus, OH 43216-1049
E-mail address: Rebecca.McKinney@epa.ohio.gov
Phone: (614) 644-3636
Fax: (614) 644-3687

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

This form is intended to capture the DBE[1] subcontractor's[2] description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package.

Subcontractor Name	Project Name	
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity:	

Contract Item Number	**Description of Work Submitted to the Prime Contractor Involving Construction, Services , Equipment or Supplies**	**Price of Work Submitted to the Prime Contractor**
DBE Certified By: ○ DOT ○ SBA ○ Other: _____	Meets/ exceeds EPA certification standards? ○ YES ○ NO ○ Unknown	

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

FORM 6100-3 (DBE Subcontractor Performance Form)

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	**Print Name**
Title	**Date**

Subcontractor Signature	**Print Name**
Title	**Date**

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractors[2] and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name		Project Name
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Issuing/Funding Entity:		

I have identified potential DBE certified subcontractors	___YES	___NO
If yes, please complete the table below. If no, please explain:		

Subcontractor Name/ Company Name	**Company Address/ Phone/ Email**	**Est. Dollar Amt.**	**Currently DBE Certified?**

Continue on back if needed

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	**Print Name**
Title	**Date**

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form

An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE[1] subcontractor[2] the opportunity to describe work received and/or report any concerns regarding the EPA-funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name	Project Name	
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity:	

Contract Item Number	**Description of Work Received from the Prime Contractor Involving Construction, Services , Equipment or Supplies**	**Amount Received by Prime Contractor**

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form

Please use the space below to report any concerns regarding the above EPA-funded project:

Subcontractor Signature	**Print Name**
Title	**Date**

OMB CONTROL NO. 2030-0020
APPROVED: 06/30/2014
APPROVAL EXPIRES: 06/30/2017

U.S. ENVIRONMENTAL PROTECTION AGENCY
MBE/WBE UTILIZATION UNDER FEDERAL GRANTS AND COOPERATIVE AGREEMENTS

PART I. (Reports are required even if no procurements are made during the reporting period.)

1A. FEDERAL FISCAL YEAR (Oct. 1-Sep 30) 20_____	1B. REPORTING PERIOD (Check ALL appropriate boxes) ☐ 1st (Oct-Dec) ☐ 2nd (Jan-Mar) ☐ 3rd (Apr-Jun) ☐ 4th (Jul-Sep) ☐ Semi-Annual (Oct-Mar) ☐ Semi-Annual (Apr-Sep) ☐ Annual ☐ Check if this is the last report for the project (Project completed).
1C. REVISION OF A PRIOR REPORT? Y or N Year: _____ Quarter: _____	BRIEFLY DESCRIBE THE REVISIONS YOU ARE MAKING:

2A. EPA FINANCIAL ASSISTANCE OFFICE ADDRESS (ATTN: DBE Coordinator)		3A. RECIPIENT NAME AND ADDRESS	
2B. EPA DBE COORDINATOR Name: E-mail:	2C. PHONE: Fax:	3B. RECIPIENT REPORTING CONTACT: Name: E-mail:	3C. PHONE: Fax:
4A. FINANCIAL ASSISTANCE AGREEMENT ID NUMBER (SRF State Recipients, refer to Instructions for Completion of blocks 4A, 5A and 5C.)		4B. FEDERAL FINANCIAL ASSISTANCE PROGRAM TITLE or CFDA NUMBER:	

5A. TOTAL ASSISTANCE AGREEMENT AMOUNT (SRF State Recipients, refer to Instructions for Completion of blocks 4A, 5A and 5C.) EPA Share: $_____ Recipient Share: $_____	5B. If NO procurement and NO accomplishments were made this reporting period (by the recipients, sub-recipients, loan recipients, and prime contractors), **CHECK** and **SKIP** to Block No. 7. (Procurements are all expenditures through contract, order, purchase, lease or barter of supplies, equipment, construction, or services needed to complete Federal assistance programs. Accomplishments, in this context, are procurements made with MBEs and/or WBEs. ☐

5C. Total Procurements This Reporting Period
(Only include amount not reported in any prior reporting period)

Total Procurement Amount $_____(Include total dollar values awarded by recipient, sub-recipients and SRF loan recipients, **including MBE/WBE expenditures.**)

5D.
Were sub-awards issued under this assistance agreement? Yes ☐ No ☐ Were contracts issued under this assistance agreement ? Yes ☐ No ☐

5E. MBE/WBE Accomplishments This Reporting Period

Actual MBE/WBE Procurement Accomplished:
(Include total dollar values awarded by recipient, sub-recipients, SRF loan recipients and Prime Contractors.)

	Construction	Equipment	Services	Supplies	Total
$MBE:					
$WBE:					

6. COMMENTS: (If no MBE/WBE procurements were accomplished during the reporting period, please explain what steps you are taking to achieve the MBE/WBE Program requirements specified in the terms and conditions of the Assistance Agreement.)

7. NAME OF RECIPIENT'S AUTHORIZED REPRESENTATIVE	TITLE
8. SIGNATURE OF RECIPIENT'S AUTHORIZED REPRESENTATIVE	DATE

PART II. **MBE/WBE PROCUREMENTS MADE DURING REPORTING PERIOD**

EPA Financial Assistance Agreement Number: _____

1. Procurement Made By			2. Business Enterprise		3. $ Value of Procurement	4. Date of Procurement MM/DD/YY	5. Type of Product or Services[A] (Enter Code)	6. Name/Address/Phone Number of MBE/WBE Contractor or Vendor
Recipient	Sub-Recipient and/or SRF Loan Recipient	Prime	Minority	Women				

Type of product or service codes:

1 = Construction 2 = Supplies 3 = Services 4 = Equipment

Note: Refer to Terms and conditions of your Assistance Agreement to determine the frequency of reporting. Recipients are required to submit MBE/WBE reports to EPA beginning with the Federal fiscal year quarter the recipients receive the award, continuing until the project is completed.

Instructions:

A. General Instructions:

MBE/WBE utilization is based on 40 CFR Part 33. EPA Form 5700-52A must be completed by recipients of Federal grants, cooperative agreements, or other Federal financial assistance which involve procurement of supplies, equipment, construction or services to accomplish Federal assistance programs.

Recipients are required to report 30 days after the end of each federal fiscal quarter, semiannually, or annually, per the terms and conditions of the financial assistance agreement.

	Quarterly Reporting Due Date	Semiannual Reporting Due Date	Annual Reporting Due Date
Agreements awarded prior to May 27, 2008	January 30, April 30, July 30, October 30	N/A	October 30
Agreements awarded on or after May 27, 2008	N/A	April 30, October 30	October 30

MBE/WBE program requirements, including reporting, are material terms and conditions of the financial assistance agreement.

B. Definitions:

Procurement is the acquisition through contract, order, purchase, lease or barter of supplies, equipment, construction or services needed to accomplish Federal assistance programs.

A ***contract*** is a written agreement between an EPA recipient and another party (also considered "prime contracts") and any lower tier agreement (also considered "subcontracts") for equipment, services, supplies, or construction necessary to complete the project. This definition excludes written agreements with another public agency. This definition includes personal and professional services, agreements with consultants, and purchase orders.

A ***minority business enterprise*** **(MBE)** is a business concern that is (1) at least 51 percent owned by one or more minority individuals, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more minority individuals; and (2) whose daily business operations are managed and directed by one or more of the minority owners. In order to qualify and participate as an MBE prime or subcontractor for EPA recipients under EPA's DBE Program, an entity must be properly certified as required by 40 CFR Part 33, Subpart B.

U.S. citizenship is required. Recipients shall presume that minority individuals include Black Americans, Hispanic Americans, Native Americans, Asian Pacific Americans, or other groups whose members are found to be disadvantaged by the Small Business Act or by the Secretary of Commerce under section 5 of Executive order 11625. The reporting contact at EPA can provide additional information.

A ***woman business enterprise*** **(WBE)** is a business concern that is, (1) at least 51 percent owned by one or more women, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more women and (2) whose daily business operations are managed and directed by one or more of the women owners. In order to qualify and participate as a WBE prime or subcontractor for EPA recipients under EPA's DBE Program, an entity must be properly certified as required by 40 CFR Part 33, Subpart B.

Business firms which are 51 percent owned by minorities or women, but are in fact managed and operated by non-minority individuals do not qualify for meeting MBE/WBE procurement goals. U.S. Citizenship is required.

Good Faith Efforts

A recipient is required to make the following good faith efforts whenever procuring construction, equipment, services, and supplies under an EPA financial assistance agreement. These good faith efforts for utilizing MBEs and WBEs must be documented. Such documentation is subject to EPA review upon request:

1. Include of MBEs/WBEs on solicitation lists.
2. Assure that MBEs/WBEs are solicited once they are identified.
3. Divide total requirements into smaller tasks to permit maximum MBE/WBE participation, where feasible.
4. Establish delivery schedules which will encourage MBE/WBE participation, where feasible.
5. Encourage use of the services of the U.S. Department of Commerce's Minority Business Development Agency (MBDA) and the U.S. Small Business Administration to identify MBEs/WBEs.

6. Require that each party to a subgrant, subagreement, or contract award take the good faith efforts outlined here.

C. Instructions for Part I:

1a. Specify Federal fiscal year this report covers. The Federal fiscal year runs from October 1st through September 30th (**e.g. November 29, 2010 falls within Federal fiscal year 2011**)

1b. Check applicable reporting box, quarterly, semiannually, or annually. Also indicate if this is the last report for the project.

1c. Indicate if this is a revision to a previous year, half-year, or quarter, and provide a brief description of the revision you are making.

2a-c. Please refer to your financial assistance agreement for the mailing address of the EPA financial assistance office for your agreement.

The "EPA DBE Reporting Contact" is the DBE Coordinator for the EPA Region from which your financial assistance agreement was originated. For a list of DBE Coordinators please refer to the EPA OSBP website at www.epa.gov/osbp. Click on "Regional Contacts" for the name of your coordinator.

3a-c. Identify the agency, state authority, university or other organization which is the recipient of the Federal financial assistance and the person to contact concerning this report.

4a. Provide the Assistance Agreement number assigned by EPA. A separate report must be submitted for each Assistance Agreement.

***For SRF recipients**: In box 4a list numbers for ALL OPEN Assistance Agreements being reported on this form. Please note that although the New DBE Rule (which took effect May 27, 2008) revised the reporting frequency requirements from quarterly to semiannually, that change only applies to agreements awarded AFTER the New DBE Rule took effect. Therefore, SRF recipients may either continue to report activity for all Agreements on one form on a quarterly basis until the last award that was made prior to the New DBE Rule has been closed out; OR, the recipient may split the submission of SRF reports into quarterly reports for Agreements awarded prior the New DBE Rule, and semiannually for the awards made after the New DBE Rule.

4b. Refer back to Assistance Agreement document for this information.

5a. Provide the total amount of the Assistance Agreement which includes Federal funds plus recipient matching funds and funds from other sources.

***For SRF recipients only**: SRF recipients will not enter an amount in 5a. Please leave 5a blank.

5b. Self-explanatory.

5c. Provide the total dollar amount of **ALL** procurements awarded this reporting period by the recipient, sub-recipients, and SRF loan recipients, **including** MBE/WBE expenditures. For example: Actual dollars for procurement from the procuring office; actual contracts let from the contracts office; actual goods, services, supplies, etc., from other sources including the central purchasing/ procurement centers).

***NOTE**: To prevent double counting on line 5C, if any amount on 5E is for a subcontract and the prime contract has already been included on Line 5C in a prior reporting period, then report the amount going to MBE or WBE subcontractor on line 5E, but exclude the amount from Line 5C. To include the amount on 5C again would result in double counting because the prime contract, which includes the subcontract, would have already been reported.

5d. State whether or not sub-awards and/or subcontracts have been issued under the assistance agreement by indicating "yes" or "no".

5e. Where requested, also provide the total dollar amount of all MBE/WBE procurement awarded during this reporting period by the recipient, sub-recipients, SRF loan recipients, and prime contractors in the categories of construction, equipment, services and supplies. These amounts include Federal funds plus recipient matching funds and funds from other sources.

***For SRF recipients only**: In 5c please enter the total procurement amount for the quarter, or semiannual period, under all of your SRF Assistance Agreements. The figure reported in this section is **not** directly tied to an individual Assistance Agreement identification number. **(SRF state recipients report state procurements in this section)**

6. If there were no MBE/WBE accomplishments this reporting period, please briefly explain what

specific steps you are taking to achieve the MBE/WBE requirements specified in the terms and conditions of the Assistance Agreement.

7. Name and title of official administrator or designated reporting official.

8. Signature, month, day, and year report submitted.

D. Instructions for Part II:

For each MBE/WBE procurement made under this assistance agreement during the reporting period, provide the following information:

1. Check whether this procurement was made by the recipient, sub-recipient/SRF loan recipient, or the prime contractor.

2. Check either the MBE or WBE column. If a firm is both an MBE and WBE, the recipient may choose to count the entire procurement towards EITHER its MBE or WBE accomplishments. The recipient may also divide the total amount of the procurement (using any ratio it so chooses) and count those divided amounts toward its MBE and WBE accomplishments. If the recipient chooses to divide the procurement amount and count portions toward its MBE and WBE accomplishments, please state the appropriate amounts under the MBE and WBE columns on the form. **The combined MBE and WBE amounts for that MBE/WBE contractor must not exceed the "Value of the Procurement" reported in column #3**

3. Dollar value of procurement.

4. Date of procurement, shown as month, day, year. Date of procurement is defined as the date the contract or procurement was awarded, **not** the date the contractor received payment under the awarded contract or procurement, unless payment occurred on the date of award. **(Where direct purchasing is the procurement method, the date of procurement is the date the purchase was made)**

5. Using codes at the bottom of the form, identify type of product or service acquired through this procurement (e.g., enter 1 if construction, 2 if supplies, etc).

6. Name, address, and telephone number of MBE/WBE firm.

**This data is requested to comply with provisions mandated by: statute or regulations and 33); OMB Circulars; or added by EPA to ensure sound and effective assistance management. Accurate, complete data are required to obtain funding, while no pledge of confidentiality is provided.

The public reporting and recording burden for this collection of information is estimated to average l hour per response annually. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclosure or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, OPPE Regulatory Information Division, U.S. Environmental Protection Agency (2136), 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460. Include the OMB Control number in any correspondence. Do not send the completed form to this address.

Certification Regarding Debarment, Suspension, and Other Responsibility Matters INSTRUCTIONS

Under Executive Order 12549 an individual or organization debarred or excluded from participation in Federal assistance or benefit programs may not receive any assistance award under a Federal program or a subagreement thereunder for $25,000 or more.

Accordingly, each prospective recipient of an EPA grant, loan, or cooperative agreement and any contract or subagreement participant thereunder must complete the attached certification provide an explanation why they cannot. For further details, see the regulation 40 CFR 32.510, Participants' responsibilities.

Go to www.epls.gov to access the Excluded Parties List System (EPLS). The EPLS includes information regarding entities debarred, suspended, proposed for debarment, excluded or disqualified under the nonprocurement common rule, or otherwise declared ineligible from receiving Federal contracts, certain subcontracts, and certain Federal assistance and benefits. This information may include names, addresses, DUNS numbers, Social Security Numbers, Employer Identification Numbers or other Taxpayer Identification Numbers, if available and deemed appropriate and permissible to publish by the agency taking the action.

Where To Submit

The prospective EPA grant, loan, or cooperative agreement recipient must return the signed certification or explanation with its application to Ohio EPA.

A prospective prime contractor must submit a complete certification or explanation to the individual or organization awarding the contract.

Each prospective subcontractor must submit a complete certification or explanation to the prime contractor for the project.

Applicants may reproduce these materials as needed and provide them to their prospective prime contractor, who, in turn, may reproduce and provide them to prospective subcontractors.

Additional copies / assistance may be requested from:

Ohio EPA
Division of Environmental and Financial Assistance
P.O. Box 1049
Columbus, Ohio 43216-1049
(614) 644-2798
www.epa.state.oh.us/defa/

Certification Regarding Debarment, Suspension, and Other Responsibility Matters

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal of State antitrust statues or commission if embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (b) of this certification;

(d) Have not within a three year period preceding this application / proposal had one or more public transactions (Federal, State, or local) terminated for cause or default; and

(e) Will not utilize a subcontractor or supplier who is unable to certify (a) through (d) above.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to 5 years, or both.

_____

Type Name & Title of Authorized Representative

_____

Signature of Authorized Representative

_____

Date

I am unable to certify to the above statements. My explanation is attached.

Contractor Equal Employment Opportunity Certification

During the performance of this contract, the undersigned agrees as follows:

1. The undersigned will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The undersigned will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The undersigned agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this equal opportunity (federally assisted construction) clause.

2. The undersigned will, in all solicitations or advertisements for employees placed by or on behalf of the undersigned, state the all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

3. The undersigned will send to each labor union or representative of workers, with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representative of the undersigned's commitment under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

4. The undersigned will comply with all provisions of Executive Order No. 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

5. The undersigned will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and relevant orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records and accounts by the administering agency of the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

6. In the event of the undersigned's non-compliance with the equal opportunity (federally assisted construction) clause of this contract of with any of the said rules, regulations, or orders, this contract may be canceled, terminated or suspended in whole or in part, and the undersigned may be declared ineligible for further Government contracts of federally assisted construction contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No 11246 of September 24, 1965, or by rules, regulations, or order of the Secretary of Labor, or as provided by law.

7. The undersigned will include this equal opportunity (federally assisted construction) clause in every subcontract or purchase order unless exempted by the rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order No 11246 of September 24, 1965, so that such provision will be binding upon each subcontract or vender. The undersigned will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for non compliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor, as a result of such direction by the administering agency the undersigned may request the United States to enter into such litigation to protect the interest of the United States.

_____

(Signature) (Date)

_____

(Name and Title of Signer, Please type)

_____

(Firm Name)

AMERICAN IRON AND STEEL ACKNOWLEDGEMENT

The Contractor acknowledges to and for the benefit of the City of _____ ("Purchaser") and the State of Ohio (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

_____ _____

Signature Date

_____

Name and Title of Authorized Signatory, Please Print or Type

_____

Bidder's Firm

☐ Check here if the WPCLF or WSRLA applicant will be requesting an individual waiver for non-American made iron and steel products. Please note that the waiver box does not need to be marked for nationwide waivers.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 20 2014

OFFICE OF WATER

MEMORANDUM

SUBJECT: Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014

FROM: Andrew D. Sawyers, Director
Office of Wastewater Management (4201M)

Peter C. Grevatt, Director
Office of Ground Water and Drinking Water (4601M)

TO: Water Management Division Directors
Regions I - X

P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an "American Iron and Steel (AIS)" requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works if the project is funded through an assistance agreement executed beginning January 17, 2014 (enactment of the Act), through the end of Federal Fiscal Year 2014.

Section 436 also sets forth certain circumstances under which EPA may waive the AIS requirement. Furthermore, the Act specifically exempts projects where engineering plans and specifications were approved by a State agency prior to January 17, 2014.

The approach described below explains how EPA will implement the AIS requirement. The first section is in the form of questions and answers that address the types of projects that must comply with the AIS requirement, the types of products covered by the AIS requirement, and compliance. The second section is a step-by-step process for requesting waivers and the circumstances under which waivers may be granted.

Implementation

The Act states:

Sec. 436. (a)(1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term ‘‘iron and steel products’’ means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the ‘‘Administrator’’) finds that—

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

(e) The Administrator may retain up to 0.25 percent of the funds appropriated in this Act for the Clean and Drinking Water State Revolving Funds for carrying out

the provisions described in subsection (a)(1) for management and oversight of the requirements of this section.

(f) This section does not apply with respect to a project if a State agency approves the engineering plans and specifications for the project, in that agency's capacity to approve such plans and specifications prior to a project requesting bids, prior to the date of the enactment of this Act.

The following questions and answers provide guidance for implementing and complying with the AIS requirements:

Project Coverage

1) What classes of projects are covered by the AIS requirement?

All treatment works projects funded by a CWSRF assistance agreement, and all public water system projects funded by a DWSRF assistance agreement, from the date of enactment through the end of Federal Fiscal Year 2014, are covered. The AIS requirements apply to the entirety of the project, no matter when construction begins or ends. Additionally, the AIS requirements apply to all parts of the project, no matter the source of funding.

2) Does the AIS requirement apply to nonpoint source projects or national estuary projects?

No. Congress did not include an AIS requirement for nonpoint source and national estuary projects unless the project can also be classified as a 'treatment works' as defined by section 212 of the Clean Water Act.

3) Are any projects for the construction, alteration, maintenance, or repair of a public water system or treatment works excluded from the AIS requirement?

Any project, whether a treatment works project or a public water system project, for which engineering plans and specifications were approved by the responsible state agency prior to January 17, 2014, is excluded from the AIS requirements.

4) What if the project does not have approved engineering plans and specifications but has signed an assistance agreement with a CWSRF or DWSRF program prior to January 17, 2014?

The AIS requirements do not apply to any project for which an assistance agreement was signed prior to January 17, 2014.

5) What if the project does not have approved engineering plans and specifications, but bids were advertised prior to January 17, 2014 and an assistance agreement was signed after January 17, 2014?

If the project does not require approved engineering plans and specifications, the bid advertisement date will count in lieu of the approval date for purposes of the exemption in section 436(f).

6) What if the assistance agreement that was signed prior to January 17, 2014, only funded a part of the overall project, where the remainder of the project will be funded later with another SRF loan?

If the original assistance agreement funded any construction of the project, the date of the original assistance agreement counts for purposes of the exemption. If the original assistance agreement was only for planning and design, the date of that assistance agreement will count for purposes of the exemption only if there is a written commitment or expectation on the part of the assistance recipient to fund the remainder of the project with SRF funds.

7) What if the assistance agreement that was signed prior to January 17, 2014, funded the first phase of a multi-phase project, where the remaining phases will be funded by SRF assistance in the future?

In such a case, the phases of the project will be considered a single project if all construction necessary to complete the building or work, regardless of the number of contracts or assistance agreements involved, are closely related in purpose, time and place. However, there are many situations in which major construction activities are clearly undertaken in phases that are distinct in purpose, time, or place. In the case of distinct phases, projects with engineering plans and specifications approval or assistance agreements signed prior to January 17, 2014 would be excluded from AIS requirements while those approved/signed on January 17, 2014, or later would be covered by the AIS requirements.

8) What if a project has split funding from a non-SRF source?

Many States intend to fund projects with "split" funding, from the SRF program and from State or other programs. Based on the Act language in section 436, which requires that American iron and steel products be used in any project for the construction, alteration, maintenance, or repair of a public water system or treatment works receiving SRF funding between and including January 17, 2014 and September 30, 2014, any project that is funded in whole or in part with such funds must comply with the AIS requirement. A "project" consists of all construction necessary to complete the building or work regardless of the number of contracts or assistance agreements involved so long as all contracts and assistance agreements awarded are closely related in purpose, time and place. This precludes the intentional splitting of SRF projects into separate and smaller contracts or assistance agreements to avoid AIS coverage on some portion of a larger

project, particularly where the activities are integrally and proximately related to the whole. However, there are many situations in which major construction activities are clearly undertaken in separate phases that are distinct in purpose, time, or place, in which case, separate contracts or assistance agreement for SRF and State or other funding would carry separate requirements.

9) What about refinancing?

If a project began construction, financed from a non-SRF source, prior to January 17, 2014, but is refinanced through an SRF assistance agreement executed on or after January 17, 2014 and prior to October 1, 2014, AIS requirements will apply to all construction that occurs on or after January 17, 2014, through completion of construction, unless, as is likely, engineering plans and specifications were approved by a responsible state agency prior to January 17, 2014. There is no retroactive application of the AIS requirements where a refinancing occurs for a project that has completed construction prior to January 17, 2014.

10) Do the AIS requirements apply to any other EPA programs, besides the SRF program, such as the Tribal Set-aside grants or grants to the Territories and DC?

No, the AIS requirement only applies to funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12)

Covered Iron and Steel Products

11) What is an iron or steel product?

For purposes of the CWSRF and DWSRF projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the public water system or treatment works:

Lined or unlined pipes or fittings;
Manhole Covers;
Municipal Castings (defined in more detail below);
Hydrants;
Tanks;
Flanges;
Pipe clamps and restraints;
Valves;
Structural steel (defined in more detail below);
Reinforced precast concrete; and
Construction materials (defined in more detail below).

12) What does the term 'primarily iron or steel' mean?

'Primarily iron or steel' places constraints on the list of products above. For one of the listed products to be considered subject to the AIS requirements, it must be made of greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.

13) Can you provide an example of how to perform a cost determination?

For example, the iron portion of a fire hydrant would likely be the bonnet, body and shoe, and the cost then would include the pouring and casting to create those components. The other material costs would include non-iron and steel internal workings of the fire hydrant (i.e., stem, coupling, valve, seals, etc). However, the assembly of the internal workings into the hydrant body would not be included in this cost calculation. If one of the listed products is not made primarily of iron or steel, United States (US) provenance is not required. An exception to this definition is reinforced precast concrete, which is addressed in a later question.

14) If a product is composed of more than 50% iron or steel, but is not listed in the above list of items, must the item be produced in the US? Alternatively, must the iron or steel in such a product be produced in the US?

The answer to both question is no. Only items on the above list must be produced in the US. Additionally, the iron or steel in a non-listed item can be sourced from outside the US.

15) What is the definition of steel?

Steel means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

16) What does 'produced in the United States' mean?

Production in the United States of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the

material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

17) Are the raw materials used in the production of iron or steel required to come from US sources?

No. Raw materials, such as iron ore, limestone, scrap iron, and scrap steel, can come from non-US sources.

18) If an above listed item is primarily made of iron or steel, but is only at the construction site temporarily, must such an item be produced in the US?

No. Only the above listed products made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

19) What is the definition of 'municipal castings'?

Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are:

Access Hatches;
Ballast Screen;
Benches (Iron or Steel);
Bollards;
Cast Bases;
Cast Iron Hinged Hatches, Square and Rectangular;
Cast Iron Riser Rings;
Catch Basin Inlet;
Cleanout/Monument Boxes;
Construction Covers and Frames;
Curb and Corner Guards;
Curb Openings;
Detectable Warning Plates;
Downspout Shoes (Boot, Inlet);
Drainage Grates, Frames and Curb Inlets;
Inlets;
Junction Boxes;
Lampposts;
Manhole Covers, Rings and Frames, Risers;

Meter Boxes;
Service Boxes;
Steel Hinged Hatches, Square and Rectangular;
Steel Riser Rings;
Trash receptacles;
Tree Grates;
Tree Guards;
Trench Grates; and
Valve Boxes, Covers and Risers.

20) What is 'structural steel'?

Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

21) What is a 'construction material' for purposes of the AIS requirement?

Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered "structural steel". This includes, but is not limited to, the following products: wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), welding rods, decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, and stationary screens.

22) What is not considered a 'construction material' for purposes of the AIS requirement?

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials: pumps, motors, gear reducers, drives (including variable frequency drives (VFDs)), electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators), mixers, gates, motorized screens (such as traveling screens), blowers/aeration equipment, compressors, meters, sensors, controls and switches, supervisory control and

data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, analytical instrumentation, and dewatering equipment.

23) If the iron or steel is produced in the US, may other steps in the manufacturing process take place outside of the US, such as assembly?

No. Production in the US of the iron or steel used in a listed product requires that all manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

24) What processes must occur in the US to be compliant with the AIS requirement for reinforced precast concrete?

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing bar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin.

If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

Compliance

25) How should an assistance recipient document compliance with the AIS requirement?

In order to ensure compliance with the AIS requirement, specific AIS contract language must be included in each contract, starting with the assistance agreement, all the way down to the purchase agreements. Sample language for assistance agreements and contracts can be found in Appendix 3 and 4.

EPA recommends the use of a step certification process, similar to one used by the Federal Highway Administration. The step certification process is a method to ensure that producers adhere to the AIS requirement and assistance recipients can verify that products comply with the AIS requirement. The process also establishes accountability and better enables States to take enforcement actions against violators.

Step certification creates a paper trail which documents the location of the manufacturing process involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer,

processor, etc) of the iron and steel products certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin. A certification can be quite simple. Typically, it includes the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Attached, as Appendix 5, are sample certifications. These certifications should be collected and maintained by assistance recipients.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes occurred in the US. While this type of certification may be acceptable, it may not provide the same degree of assurance. Additional documentation may be needed if the certification is lacking important information. Step certification is the best practice.

26) How should a State ensure assistance recipients are complying with the AIS requirement?

In order to ensure compliance with the AIS requirement, States SRF programs must include specific AIS contract language in the assistance agreement. Sample language for assistance agreements can be found in Appendix 3.

States should also, as a best practice, conduct site visits of projects during construction and review documentation demonstrating proof of compliance which the assistance recipient has gathered.

27) What happens if a State or EPA finds a non-compliant iron and/or steel product permanently incorporated in the project?

If a potentially non-compliant product is identified, the State should notify the assistance recipient of the apparent unauthorized use of the non-domestic component, including a proposed corrective action, and should be given the opportunity to reply. If unauthorized use is confirmed, the State can take one or more of the following actions: request a waiver where appropriate; require the removal of the non-domestic item; or withhold payment for all or part of the project. Only EPA can issue waivers to authorize the use of a non-domestic item. EPA may use remedies available to it under the Clean Water Act, the Safe Drinking Water Act, and 40 CFR part 31 grant regulations, in the event of a violation of a grant term and condition.

It is recommended that the State work collaboratively with EPA to determine the appropriate corrective action, especially in cases where the State is the one who identifies the item in noncompliance or there is a disagreement with the assistance recipient.

If fraud, waste, abuse, or any violation of the law is suspected, the Office of Inspector General (OIG) should be contacted immediately. The OIG can be reached at 1-

888-546-8740 or OIG_Hotline@epa.gov. More information can be found at this website: http://www.epa.gov/oig/hotline.htm.

28) How do international trade agreements affect the implementation of the AIS requirements?

The AIS provision applies in a manner consistent with United States obligations under international agreements. Typically, these obligations only apply to direct procurement by the entities that are signatories to such agreements. In general, SRF assistance recipients are not signatories to such agreements, so these agreements have no impact on this AIS provision. In the few instances where such an agreement applies to a municipality, that municipality is under the obligation to determine its applicability and requirements and document the actions taken to comply for the State.

Waiver Process

The statute permits EPA to issue waivers for a case or category of cases where EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent.

In order to implement the AIS requirements, EPA has developed an approach to allow for effective and efficient implementation of the waiver process to allow projects to proceed in a timely manner. The framework described below will allow States, on behalf of the assistance recipients, to apply for waivers of the AIS requirement directly to EPA Headquarters. Only waiver requests received from states will be considered. Pursuant to the Act, EPA has the responsibility to make findings as to the issuance of waivers to the AIS requirements.

Definitions

The following terms are critical to the interpretation and implementation of the AIS requirements and apply to the process described in this memorandum:

Reasonably Available Quantity: The quantity of iron or steel products is available or will be available at the time needed and place needed, and in the proper form or specification as specified in the project plans and design.

Satisfactory Quality: The quality of iron or steel products, as specified in the project plans and designs.

Assistance Recipient: A borrower or grantee that receives funding from a State CWSRF or DWSRF program.

Step-By-Step Waiver Process

Application by Assistance Recipient

Each local entity that receives SRF water infrastructure financial assistance is required by section 436 of the Act to use American made iron and steel products in the construction of its project. However, the recipient may request a waiver. Until a waiver is granted by EPA, the AIS requirement stands, except as noted above with respect to municipalities covered by international agreements.

The waiver process begins with the SRF assistance recipient. In order to fulfill the AIS requirement, the assistance recipient must in good faith design the project (where applicable) and solicit bids for construction with American made iron and steel products. It is essential that the assistance recipient include the AIS terms in any request for proposals or solicitations for bids, and in all contracts (see Appendix 3 for sample construction contract language). The assistance recipient may receive a waiver at any point before, during, or after the bid process, if one or more of three conditions is met:

1. Applying the American Iron and Steel requirements of the Act would be inconsistent with the public interest;
2. Iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
3. Inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Proper and sufficient documentation must be provided by the assistance recipient. A checklist detailing the types of information required for a waiver to be processed is attached as Appendix 1.

Additionally, it is strongly encouraged that assistance recipients hold pre-bid conferences with potential bidders. A pre-bid conference can help to identify iron and steel products needed to complete the project as described in the plans and specifications that may not be available from domestic sources. It may also identify the need to seek a waiver prior to bid, and can help inform the recipient on compliance options.

In order to apply for a project waiver, the assistance recipient should email the request in the form of a Word document (.doc) to the State SRF program. It is strongly recommended that the State designate a single person for all AIS communications. The State SRF designee will review the application for the waiver and determine whether the necessary information has been included. Once the waiver application is complete, the State designee will forward the application to either of two email addresses. For CWSRF waiver requests, please send the application to: cwsrfwaiver@epa.gov. For DWSRF waiver requests, please send the application to: dwsrfwaiver@epa.gov.

Evaluation by EPA

After receiving an application for waiver of the AIS requirements, EPA Headquarters will publish the request on its website for 15 days and receive informal comment. EPA Headquarters will then use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.

In the event that EPA finds that adequate documentation and justification has been submitted, the Administrator may grant a waiver to the assistance recipient. EPA will notify the State designee that a waiver request has been approved or denied as soon as such a decision has been made. Granting such a waiver is a three-step process:

1. Posting – After receiving an application for a waiver, EPA is required to publish the application and all material submitted with the application on EPA's website for 15 days. During that period, the public will have the opportunity to review the request and provide informal comment to EPA. The website can be found at: http://water.epa.gov/grants_funding/aisrequirement.cfm

2. Evaluation – After receiving an application for waiver of the AIS requirements, EPA Headquarters will use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.

3. Signature of waiver approval by the Administrator or another agency official with delegated authority – As soon as the waiver is signed and dated, EPA will notify the State SRF program, and post the signed waiver on our website. The assistance recipient should keep a copy of the signed waiver in its project files.

Public Interest Waivers

EPA has the authority to issue public interest waivers. Evaluation of a public interest waiver request may be more complicated than that of other waiver requests so they may take more time than other waiver requests for a decision to be made. An example of a public interest waiver that might be issued could be for a community that has standardized on a particular type or manufacturer of a valve because of its performance to meet their specifications. Switching to an alternative valve may require staff to be trained on the new equipment and additional spare parts would need to be purchased and stocked, existing valves may need to be unnecessarily replaced, and portions of the system may need to be redesigned. Therefore, requiring the community to install an alternative valve would be inconsistent with public interest.

EPA also has the authority to issue a public interest waiver that covers categories of products that might apply to all projects.

EPA reserves the right to issue national waivers that may apply to particular classes of assistance recipients, particular classes of projects, or particular categories of iron or steel products. EPA may develop national or (US geographic) regional categorical waivers through the identification of similar circumstances in the detailed justifications presented to EPA in a waiver request or requests. EPA may issue a national waiver based on policy decisions regarding the public's interest or a determination that a particular item is not produced domestically in reasonably available quantities or of a sufficient quality. In such cases, EPA may determine it is necessary to issue a national waiver.

If you have any questions concerning the contents of this memorandum, you may contact us, or have your staff contact Jordan Dorfman, Attorney-Advisor, State Revolving Fund Branch, Municipal Support Division, at dorfman.jordan@epa.gov or (202) 564-0614 or Kiri Anderer, Environmental Engineer, Infrastructure Branch, Drinking Water Protection Division, at anderer.kirsten@epa.gov or (202) 564-3134.

Attachments

Appendix 1: Information Checklist for Waiver Request

The purpose of this checklist is to help ensure that all appropriate and necessary information is submitted to EPA. EPA recommends that States review this checklist carefully and provide all appropriate information to EPA. This checklist is for informational purposes only and does not need to be included as part of a waiver application.

Items	✓	Notes
General • Waiver request includes the following information: — Description of the foreign and domestic construction materials — Unit of measure — Quantity — Price — Time of delivery or availability — Location of the construction project — Name and address of the proposed supplier — A detailed justification for the use of foreign construction materials • Waiver request was submitted according to the instructions in the memorandum • Assistance recipient made a good faith effort to solicit bids for domestic iron and steel products, as demonstrated by language in requests for proposals, contracts, and communications with the prime contractor		
Cost Waiver Requests • Waiver request includes the following information: — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products — Relevant excerpts from the bid documents used by the contractors to complete the comparison — Supporting documentation indicating that the contractor made a reasonable survey of the market, such as a description of the process for identifying suppliers and a list of contacted suppliers		
Availability Waiver Requests • Waiver request includes the following supporting documentation necessary to demonstrate the availability, quantity, and/or quality of the materials for which the waiver is requested: — Supplier information or pricing information from a reasonable number of domestic suppliers indicating availability/delivery date for construction materials — Documentation of the assistance recipient's efforts to find available domestic sources, such as a description of the process for identifying suppliers and a list of contacted suppliers. — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of construction materials • Waiver request includes a statement from the prime contractor and/or supplier confirming the non-availability of the domestic construction materials for which the waiver is sought • Has the State received other waiver requests for the materials described in this waiver request, for comparable projects?		

Appendix 2: HQ Review Checklist for Waiver Request

Instructions: To be completed by EPA. Review all waiver requests using the questions in the checklist, and mark the appropriate box as Yes, No or N/A. Marks that fall inside the shaded boxes may be grounds for denying the waiver. If none of your review markings fall into a shaded box, the waiver is eligible for approval if it indicates that one or more of the following conditions applies to the domestic product for which the waiver is sought:

1. The iron and/or steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.
2. The inclusion of iron and/or steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Review Items	Yes	No	N/A	Comments
Cost Waiver Requests • Does the waiver request include the following information? — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products — Relevant excerpts from the bid documents used by the contractors to complete the comparison — A sufficient number of bid documents or pricing information from domestic sources to constitute a reasonable survey of the market • Does the Total Domestic Project exceed the Total Foreign Project Cost by more than 25%?				
Availability Waiver Requests • Does the waiver request include supporting documentation sufficient to show the availability, quantity, and/or quality of the iron and/or steel product for which the waiver is requested? — Supplier information or other documentation indicating availability/delivery date for materials — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of materials • Does supporting documentation provide sufficient evidence that the contractors made a reasonable effort to locate domestic suppliers of materials, such as a description of the process for identifying suppliers and a list of contacted suppliers? • Based on the materials delivery/availability date indicated in the supporting documentation, will the materials be unavailable when they are needed according to the project schedule? (By item, list schedule date and domestic delivery quote date or other relevant information) • Is EPA aware of any other evidence indicating the non-availability of the materials for which the waiver is requested? Examples include: — Multiple waiver requests for the materials described in this waiver request, for comparable projects in the same State — Multiple waiver requests for the materials described in this waiver request, for comparable projects in other States — Correspondence with construction trade associations indicating the non-availability of the materials • Are the available domestic materials indicated in the bid documents of inadequate quality compared those required by the project plans, specifications, and/or permits?				

Appendix 3: Example Loan Agreement Language

ALL ASSISTANCE AGREEMENT MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN SRF ASSISTANCE AGREEMENTS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE LAW:

Comply with all federal requirements applicable to the Loan (including those imposed by the 2014 Appropriations Act and related SRF Policy Guidelines) which the Participant understands includes, among other, requirements that all of the iron and steel products used in the Project are to be produced in the United States ("American Iron and Steel Requirement") unless (i) the Participant has requested and obtained a waiver from the Agency pertaining to the Project or (ii) the Finance Authority has otherwise advised the Participant in writing that the American Iron and Steel Requirement is not applicable to the Project.

Comply with all record keeping and reporting requirements under the Clean Water Act/Safe Drinking Water Act, including any reports required by a Federal agency or the Finance Authority such as performance indicators of program deliverables, information on costs and project progress. The Participant understands that (i) each contract and subcontract related to the Project is subject to audit by appropriate federal and state entities and (ii) failure to comply with the Clean Water Act/Safe Drinking Water Act and this Agreement may be a default hereunder that results in a repayment of the Loan in advance of the maturity of the Bonds and/or other remedial actions.

Appendix 4: Sample Construction Contract Language

ALL CONTRACTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN ALL CONTRACTS IN PROJECTS THAT USE SRF FUNDS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE OR LOCAL LAW:

The Contractor acknowledges to and for the benefit of the City of ("Purchaser") and the (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

Appendix 5: Sample Certifications

The following information is provided as a sample letter of **step** certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Step Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

_____

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

The following information is provided as a sample letter of certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

_____

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

American Iron & Steel (AIS) Requirement of the Consolidated Appropriations Act of 2014 (Public Law 113-76)

Q&A Part 2

PRODUCT QUESTIONS

1. **Q: Do all fasteners qualify for de minimis exemption?**

   A: No. There is no broad exemption for fasteners from the American Iron and Steel (AIS) requirements. Significant fasteners used in SRF projects are not subject to the de minimis waiver for projects and must comply with the AIS requirements. Significant fasteners include fasteners produced to industry standards (e.g., ASTM standards) and/or project specifications, special ordered or those of high value. When bulk purchase of unknown-origin fasteners that are of incidental use and small value are used on a project, they may fall under the national de minimis waiver for projects. The list of potential items could be varied, such as big-box/hardware-store-variety screws, nails, and staples. The key characteristics of the items that may qualify for the de minimis waiver would be items that are incidental to the project purpose (such as drywall screws) and not significant in value or purpose (such as common nails or brads). See the following: http://water.epa.gov/grants_funding/upload/Deminimis-Waiver-04-15-14.pdf.

   EPA also clarifies that minor components of two listed products – valves and hydrants -- may not need to meet the AIS requirements if the minor components compromise a very small quantity of minor, low-cost fasteners that are of unknown origin. See EPA's questions and answers on the subject at the following: http://water.epa.gov/grants_funding/upload/AIS-QandA-Part-1-Valves-and-Hydrants-final.pdf.

2. **Q: Does PCCP pipe have to be domestically produced?**

   A: Yes. Pre-stressed concrete cylinder pipe (PCCP) or other similar concrete cylinder pipes would be comparable to pre-cast concrete which is specifically listed in the Consolidated Appropriations Act of 2014 as a product subject to the AIS requirement.

3. **Q: If the iron or steel is made from recycled metals will the vendor/supplier have to provide a certification document certifying that the recycled metals are domestically produced?**

   A: No. Recycled source materials used in the production of iron and steel products do not have to come from the U.S. Iron or steel scrap, for instance, are considered raw materials that may come from anywhere. While certification is not required for the raw material, EPA does recommend that additional final processing of iron and steel be certified to have occurred in the U.S.

4. **Q: Do tanks used for filtration systems, if delivered to the construction site separately and then filled with filtration media onsite, have to be domestically produced?**

A: No. Tanks that are specifically designed to be filters, or as parts of a filtration system, do not have to be domestically produced because these parts are no longer simply tanks, even if the filter media has not been installed and will be installed at the project site, as is customary to do for shipping purposes. These parts have only one purpose which is to be housing for filters and cannot be used in another fashion.

5. **Q: Can a recipient use non-domestic flanged pipe?**

   A: No. While the Consolidated Appropriations Act of 2014 does not specifically mention flanged pipe, since it does mention both pipe and flanges, both products would need to be domestically produced. Therefore, flanged pipe would also need to be domestically produced.

6. **Q: Can a recipient use non-domestic couplings, expansion joints, and other similar pipe connectors?**

   A: No. These products would be considered specialty fittings, due to their additional functionality, but still categorized under the larger "fitting" categorization. Fittings are defined as a material that joins pipes together or connects to a pipe (AWWA, The Drinking Water Dictionary, 2000). Therefore, these products must comply with the AIS requirements and be produced domestically.

7. **Q: Can a recipient use non-domestic service saddles and tapping sleeves?**

   A: No. These products are necessary for pipe repair, to tap a water main, or to install a service or house connection. Therefore, they are included under the larger "pipe restraint" category which is a specifically identified product subject to the domestic preference in the Consolidated Appropriations Act of 2014.

8. **Q: The AIS guidance does not appear to cover reused items (i.e., existing pipe fittings, used storage tanks, reusing existing valves). How should reused items be addressed?**

   A: The AIS guidance does not address reuse of items. Reuse of items that would otherwise be covered by AIS is acceptable provided that the item(s) was originally purchased prior to January 17, 2014, the reused item(s) is not substantially altered from original form/function, and any restoration work that may be required does not include the replacement or addition of foreign iron or steel replacement parts. EPA recommends keeping a log of these reused items by including them on the assistance recipient's de minimis list, and stating therein that these items are reused products. The donation of new items (such as a manufacturer waiving cost for certain delivered items because of concerns regarding the origin of a new product) is not, however, considered reuse.

9. **Q: What does "time needed" mean in the AIS guidance, in reference to the definition of "Reasonably Available Quantity"?**

A: For considering whether a product would meet reasonably available quantity, "time needed" is based on the construction schedule. If the item is delayed and there is substantial impact on the overall construction schedule, this would not be according to the "time needed."

10. **Q: If a product is not specifically included on the list of AIS covered products, must it comply with AIS?**

    A: Possibly. The AIS requirements include a list of specifically covered products, one of which is construction materials, a broad category of potential products. For construction materials, EPA's AIS guidance includes a set of example items that it considers construction materials composed primarily of iron and steel and covered by the Act. This example list in the guidance is not an all-inclusive list of potential construction materials. However, the guidance also includes a list of items that EPA specifically does not consider construction materials, generally those of electrical or complex-mechanical nature. If a product is similar to the ones in the non-construction material list (and it is also not specifically listed by the Act), it is not a construction material. For all other items specifically included in the Act, coverage is generally self-evident.

11. **Q: If a listed iron and steel product is used as a part for an assembled product that is non-domestic, do the AIS requirements apply?**

    A: AIS requirements only apply to the final product as delivered to the work site and incorporated into the project. Other assemblies, such as a pumping assembly or a reverse osmosis package plant, are distinct products not listed and do not need to be made in the U.S. or composed of all U.S. parts. Therefore, for the case of a non-covered product used in a larger non-domestic assembly, the components, even if specifically listed in the Consolidated Appropriations Act, do not have to be domestically produced.

12. **Q: Is cast iron excluded from the AIS requirements?**

    A: No. Cast iron products that fall under the definition of iron and steel products must comply with the AIS requirements.

13. **Q: The guidance states that "construction materials" do not include mechanical equipment, but then identifies ductwork as a construction material. Please clarify.**

    A: Ductwork is not mechanical equipment, therefore it is considered a "construction material" and must comply with the AIS requirements.

14. **Q: Do "meters" mentioned in EPA's guidance as non-construction materials include both flow meters and water meters?**

    A: Yes. "Meters" includes any type of meter, including: flow meters, wholesale meters, and water meters/service connections.

15. **Q: Must coiled steel be domestic?**

    A: Yes. Coiled steel is an intermediate product used in the production of steel pipe and must come from a U.S. source or subject to a waiver in order to comply with the AIS requirements.

16. **Q: Are pig iron, direct reduced iron (DRI), and ingot considered raw materials?**

    A: No. These are considered intermediate products used in the production of iron or steel and must come from a U.S. source or subject to a waiver in order to comply with the AIS requirements.

17. **Q: Can assistance recipients rely on a marking that reads, "Made in the USA," as evidence that all processes took place in the U.S.?**

    A: No. This designation is not consistent with our requirements that all manufacturing processes of iron and steel products must take place in the U.S.

18. **Q: When determining what constitutes a product made "primarily" of iron or steel, who makes this determination?**

    A: The manufacturer will show if its product qualifies as primarily made of iron or steel. The recipient should expect the manufacturer to provide documentation/ certification that its product is AIS compliant.

19. **Q: Do aerators need to be produced domestically in order to comply with AIS?**

    A: No. Aerators, similar to pumps, are mechanical equipment that do not need to meet the AIS requirements. "Blowers/aeration equipment, compressors" are listed in EPA's guidance as non-construction materials.

20. **Q: Are Sluice and Slide Gates considered valves?**

    A: No. Valves are products that are generally encased / enclosed with a body, bonnet, and stem. Examples include enclosed butterfly, ball, globe, piston, check, wedge, and gate valves. Furthermore, "gates" (meaning sluice, slide or weir gates) are listed in EPA's guidance as non-construction materials.

AIS PROCESS QUESTIONS

21. **Q: Will notices of waiver applications be published in the federal register?**

    A: No. Applications for waivers will be published on EPA's website (http://water.epa.gov/grants_funding/aisrequirement.cfm**).** EPA will provide 15 days for open public comment, as noted on the website.

22. Q: Will states be collecting the step certification paper trail, as presented in the AIS guidance?

A. No. Assistance recipients must maintain documentation of compliance with AIS. EPA recommends use of the step certification process. This process is a best practice and traces all manufacturing of iron and steel products to the U.S. If the process is used, the state does not have to collect the documentation. The documents must be kept by the assistance recipient and reviewed by the state during project reviews.

23. Q: Why is it considered a best practice for states to conduct site visits, when it is the assistance recipient's responsibility to meet the AIS requirements?

A: It is both the assistance recipient's and the state's responsibility to ensure compliance with the AIS requirements. The state is the recipient of a federal grant and must comply with all grant conditions, including a condition requiring that the AIS requirements be adhered to. Therefore, it is recommended that states conduct site visits of projects during construction and review documentation demonstrating the assistance recipient's proof of compliance.

24. Q: Please further define the state's role in the waiver process.

A: The state's role in the waiver process is to review any waiver requests submitted to the state in order to ensure that all necessary information has been provided by the assistance recipient prior to forwarding the request to EPA. If a state finds the request lacking, the state should work with the assistance recipient to help obtain complete information.

25. Q: How much time does EPA have to evaluate the waiver during the evaluation step?

A: At a minimum, EPA is required to provide 15 days for open public comment. There is no specific deadline or time limit for EPA to review waiver requests. Each waiver request will come with its own specific details and circumstances and may require a different amount of time for review and analysis. For example, public interest waivers in general may take longer to review than availability waivers which are typically more straightforward. However, EPA understands that construction may be delayed while waiting for a waiver and will make every effort to review and issue decisions on waiver requests in a timely manner.

PROJECT QUESTIONS

26. Q: What if a project is funded by another funding entity (i.e., United States Department of Agriculture – Rural Development) where AIS is not required and begins construction after January 17, 2014 but then applies to the SRF to refinance the project? Are they ineligible?

A: The project is not ineligible. AIS requirements will apply to any construction that occurs after the assistance agreement is signed, through the end of construction. If construction is complete, there is no retroactive application of the AIS requirements.

27. **Q: If the assistance recipient can demonstrate through market research that the AIS requirement will exceed the 25 percent cost threshold, is the entire project exempt from the AIS requirement?**

    A: If the waiver application shows that the inclusion of American iron and steel products causes the entire cost of the project to increase by more the 25 percent, a waiver may be granted for the entirety of the project.

28. **Q: Can the recipient use non-SRF funds to pay for the non-compliant item.**

    A: No. It is not an acceptable to use non-SRF funds to pay for a non-compliant item. The Consolidated Appropriations Act of 2014 requires that all iron and steel products, no matter the source of funding, must be made in the U.S. if SRF funds are used in the project.

29. **Q: What constitutes "satisfactory quality" as defined in the AIS guidance, in reference to the availability waiver process.**

    A: "Satisfactory quality" means the product meets the project design specifications. A waiver may be granted if a recipient determines that the project plans and design would be compromised because there are no American made products available that meet the project design specifications.

30. **Q: The guidance states that the AIS requirement applies to any project "funded in whole or in part" by an SRF. Where is this in the Act?**

    A: The Act states that, "None of the funds made available by a … [State SRF program] … shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States." This sentence clearly states that no SRF program may use its funds for a project unless all of the iron and steel products used in the project are made in the U.S. This is true even if only $1 of SRF funding is used in the project.

31. **Q: There is always an expectation on the part of an assistance recipient that the construction phase of a planning and/or design only loan will be funded through the SRF. If the original planning and/or design only loan was executed prior to a January 17, 2014, does this mean the entire project will be exempt from the AIS requirement?**

    A: If the original loan includes construction, and was executed prior to January 17, 2014, then the AIS provision does not apply to the project. If the original loan was only for planning and/or design, then a written commitment or documented "expectation" is needed to show exemption from the

requirements. Appearance on a priority list in an Intended Use Plan along with written reasonable assurance from the state that the recipient will receive SRF funding for project construction could provide sufficient evidence of "expectation of funding".

32. **Q: What if there has been a change order or redesign requiring new plans and specifications to be approved and they were approved after January 17, 2014: does the project now have to comply with AIS?**

    A: In most cases, no. Change orders are typically small enough changes that the original plan and specification date will still hold true. For example, if a pipe alignment has to be changed for a block or two due to unforeseen conditions, but new plans and specifications had to be submitted for this section of the project, then that could be considered a minor change. However, if there has been a major redesign, perhaps the whole project had to be redesigned starting from scratch, then the new plans and specification approval date would apply.

33. **Q: What if the bids on a project with plans and specifications approved before January 17, 2014 but the loan is signed after January 17, 2014 come in low, and there is significant funding remaining in the loan agreement, so the community designs a second project with the remaining funds: does that project have to comply with the AIS requirements?**

    A: If the second project is closely related in purpose, place and time to the first project, then the second project would be exempt from the AIS requirements. It is the assistance recipient's responsibility (with state oversight) to show that a project is closely related, or not, in purpose, place and time.

34. **Q: What if the assistance agreement was signed after January 17, 2014, state approval of plans for the first phase of the project was in place prior to January 17, 2014, but state approval of the plans for the second phase of the project was received after January 17, 2014?**

    A: In such a case, the AIS provision would not apply to the first phase of the project. If the second phase of the project is considered the same project as the first phase, due to its close relation in purpose, place and time, the entire project may be exempt. It is the assistance recipient's responsibility (with state oversight) to show that phases of a project is closely related, or not, in purpose, place and time.

35. **Q: Do products purchased through procurement-only contracts have to be comply with AIS?**

    A: Yes. For projects funded by SRF, the products procured under any form of contract must comply with AIS. A procurement-only contract generally involves the bulk purchase of common items (such as pipe, concrete, and/or pumps) of independent timing from a set of planned projects. If products which are purchased through a procurement-only contract are being installed under another contract, the procurement-only contract would probably not be considered a separate project in purpose, place and time; and therefore, would have to comply with the AIS requirements.

March 2015

American Iron & Steel Requirement for the Clean Water and Drinking Water State Revolving Funds

Q&A Part 3

*For CWSRF and DWSRF: On **January 17, 2014**, Public Law 113-76, the "Consolidated Appropriations Act, 2014," was enacted and included an American Iron and Steel requirement for the Clean Water and Drinking Water State Revolving Fund programs through the end of fiscal year 2014. Since then, the AIS requirement has continued for both programs, but through different statutes, with a few changes as described in the questions and answers provided below.*

*For CWSRF: On **June 10, 2014**, the Water Resources Reform and Development Act amended the Clean Water Act to include permanent requirements for the use of AIS products in CWSRF assistance agreements. Section 608 of the CWA now contains requirements for AIS that repeat those of the Consolidated Appropriations Act, 2014. All CWSRF assistance agreements must comply with Section 608 of the CWA for implementation of the permanent AIS requirement.*

*For DWSRF: On **December 16, 2014**, the President signed Public Law 113- 235, the "Consolidated and Further Continuing Appropriations Act, 2015," which provides fiscal year 2015 full-year appropriations through September 30, 2015. This law continues the requirement for the use of AIS products in DWSRF assistance agreements through September 30, 2015.*

CWSRF PROGRAM

1. **Q: The Water Resources Reform and Development Act amended the Clean Water Act to include permanent requirements for the use of AIS for CWSRF funded assistance agreements. Does the CWA include an exemption for plans and specifications approved prior to the enactment of the legislation similar to the exemption included in the Consolidated Appropriations Act (CAA) 2014?**

   A: Yes. The WRRDA amendment to the CWA, which included AIS requirements, included a similar exemption as the CAA 2014. For any CWSRF assistance agreement signed on or after October 1, 2014, if the plans and specifications were approved prior to June 10, 2014 (the enactment of WRRDA), then the project is exempt from AIS requirements. For assistance agreements signed prior to October 1, 2014, the previous dates in the CAA 2014 apply (see March 20, 2014, AIS guidance document).

   If a project does not require approved engineering plans and specifications, the bid advertisement date will count in lieu of the plans and specifications approval date for purposes of this exemption in Section 608 (f).

   The following table summarizes AIS exemptions based on the plans and specifications approval date for CWSRF funded projects.

CWSRF AIS Project Exemption Based on Plans and Specifications Approval Date		
Assistance Agreement Signed:	Exempt from AIS if Plans and Specifications Were Approved Before:	Basis for Exemption:
1/17/2014 through 9/30/2014	4/15/2014	• Consolidated Appropriations Act 2014 • National waiver signed 4/15/2014*
On or after 10/1/2014	6/10/2014	• Clean Water Act Section 608

** To be covered by the national waiver, the plans and specifications had to be submitted to the state prior to 1/17/2014*

2. Q: Does the AIS requirement apply to refinanced CWSRF projects?

A: Yes, in some cases. If a project began construction, financed from a non-CWSRF source prior to June 10, 2014, but is refinanced through a CWSRF assistance agreement executed on or after October 1, 2014, AIS requirements will apply to all construction that occurs on or after June 10, 2014, through completion of construction, unless engineering plans and specifications were approved by the responsible state agency prior to June 10, 2014. For CWSRF projects funded on or after October 1, 2014, there is no retroactive application of the AIS requirements where a refinancing occurs for a project that has completed construction prior to June 10, 2014.

DWSRF PROGRAM

3. Q: The Consolidated and Further Continuing Appropriations Act 2015 continues the AIS requirements for DWSRF funded assistance agreements. Does the Act include an exemption for plans and specifications approved prior to the enactment of the legislation, similar to the exemption included in the Consolidated Appropriations Act (CAA) 2014?

A: Yes. The Consolidated and Further Continuing Appropriations Act 2015 includes a similar exemption as the CAA 2014. For any assistance agreement signed on or after December 16, 2014 (the enactment of the Act), if the plans and specifications were approved prior to December 16, 2014, then the project is exempt from the AIS requirements. For assistance agreements signed prior to December 16, 2014, the previous dates in the CAA 2014 apply (see March 20, 2014 AIS guidance document).

If a project does not require approved engineering plans and specifications, the bid advertisement date will count in lieu of the plans and specifications approval date for purposes of the exemption in Section 424(f).

4. Q: Do DWSRF assistance agreements signed during the time period between September 30, 2014, and December 16, 2014, still have to comply with the AIS requirements?

A: Yes. The Continuing Appropriations Resolution 2015 was signed on September 19, 2014, which extended funding for the DWSRF with the same conditions that were made applicable by the language in the Fiscal Year 2014 appropriations, including the requirement for the use of American Iron and Steel products in projects receiving financial assistance from the DWSRF. Therefore, all assistance agreements starting October 1, 2014, through the enactment of the Consolidated and Further Continuing Appropriations Act 2015 (signed December 16, 2014), must include the AIS requirements. However, if the plans and specifications for any of these projects were approved prior to April 15, 2014 (the date the national waiver was signed), then the project is exempt from the AIS requirements.

The following table summarizes AIS exemptions based on the plans and specifications approval date for DWSRF funded projects.

DWSRF AIS Project Exemption Based on Plans and Specifications Approval Date		
Assistance Agreement Signed:	Exempt from AIS if Plans and Specifications Were Approved Before:	Basis for Exemption:
1/17/2014 through 9/30/2014	4/15/2014	• Consolidated Appropriations Act 2014 • National waiver signed 4/15/2014*
10/1/2014 through 12/15/2014	4/15/2014	• Continuing Appropriations Resolution 2015 (continued CAA 2014 requirements)** • National waiver signed 4/15/2014*
12/16/2014 through 9/30/2015	12/16/2014	• Consolidated and Further Continuing Appropriations Act 2015

** To be covered by the national waiver, the plans and specifications had to be submitted to the state prior to 1/17/2014*

*** Following the first continuing resolution, there were two additional CRs to fill the gap between 12/11/2014 and 12/16/2014*

5. Q: Does the AIS requirement apply to refinanced DWSRF projects?

A: Yes, in some cases. If a project began construction, financed from a non-DWSRF source prior to December 16, 2014, but is refinanced through a DWSRF assistance agreement executed on or after December 16, 2014, AIS requirements will apply to all construction that occurs on or after December 16, 2014, through completion of construction, unless engineering plans and

specifications were approved by the responsible state agency prior to December 16, 2014. For DWSRF projects funded on or after December 16, 2014, there is no retroactive application of the AIS requirements where a refinancing occurs for a project that has completed construction prior to December 16, 2014.

BOTH CWSRF AND DWSRF PROGRAMS

6. **Q: If a coating is applied to the external surface of a domestic iron or steel component, and the application takes place outside of the United States, would the product be compliant under the AIS requirements?**

   A: Yes. The product would still be considered a compliant product under AIS requirements. Any coating processes that are applied to the external surface of iron and steel components that would otherwise be AIS compliant would not disqualify the product from meeting the AIS requirements regardless of where the coating processes occur, provided that final assembly of the product occurs in the United States.

   The exemption above only applies to coatings on the *external surface* of iron and steel components. It does not apply to coatings or linings on internal surfaces of iron and steel products, such as the lining of lined pipes. All manufacturing processes for lined pipes, including the application of pipe lining, must occur in the United States for the product to be compliant with AIS requirements.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DECISION MEMORANDUM

OFFICE OF WA rm

SUBJECT: De Minimis Waiver of Section 436 of P.L. 113-76, Consolidated Appropriations Act (CAA), 2014

FROM: Nancy K. Stoner
Acting Assistant Administrator

The EPA is hereby granting a nationwide waiver pursuant to the "American Iron and Steel (AIS)" requirements of P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), section 436 under the authority of Section 436(b)(**1)** (public interest waiver) for de minimis incidental components of eligible water infrastructure projects. This action permits the use of products when they occur in de minimis incidental components of such projects funded by the Act that may otherwise be prohibited under section 436(a). Funds used for such de minimis incidental components cumulatively may comprise no more than a total of 5 percent of the total cost of the materials used in and incorporated into a project; the cost of an individual item may not exceed **1** percent of the total cost of the materials used in and incorporated into a project.

P.L. 1 13-76, Consolidated Appropriations Act, 2014 (Act), includes an "American Iron and Steel" (AIS) requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use specific domestic iron and steel products that are produced in the United States if the project is funded through an assistance agreement executed beginning January 17, 2014 (enactment of the Act), through the end of Fiscal Year 2014, unless the agency determines it necessary to waive this requirement based on findings set forth in Section 436(b). The Act states, "[the requirements] shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency ...finds that- (1) applying subsection (a) would be inconsistent with the public interest" 436(b**)(1**).

In implementing section 436 of the Act, the EPA must ensure that the section's requirements are applied consistent with congressional intent in adopting this section and in the broader context of the purposes, objectives, and other provisions applicable to projects funded under the SRF. Water infrastructure projects typically contain a relatively small number of high-cost components incorporated into the project. In bid solicitations for a project, these high-cost components are generally described in detail via project specific technical specifications. For these major components, utility owners and their contractors are generally familiar with the conditions of availability, the potential alternatives for each detailed specification, the approximate cost, and the country of manufacture of the available components.

Every water infrastructure project also involves the use of thousands of miscellaneous, generally low-cost components that are essential for, but incidental to, the construction and are incorporated into the physical structure of the project. For many of these incidental components, the country of manufacture and the availability of alternatives is not always readily or reasonably identifiable prior to procurement in the normal course of business; for other incidental components, the country of manufacture may be known but the miscellaneous character in conjunction with the low cost, individually and (in total) as typically procured in bulk, mark them as properly incidental. Examples of incidental components could include small washers, screws, fasteners (i.e., nuts and bolts), miscellaneous wire, comer bead, ancillary tube, etc. Examples of items that are clearly not incidental include significant process fittings (i.e., tees, elbows, flanges, and brackets), distribution system fittings and valves, force main valves, pipes for sewer collection and/or water distribution, treatment and storage tanks, large structural support structures, etc.

The EPA undertook multiple inquiries to identify the approximate scope of de minimis incidental components within water infrastructure projects during the implementation of the American Reinvestment and Recovery Act (ARRA) and its requirements (Buy American provisions, specifically). The inquiries and research conducted in 2009 applies suitably for the case today. In 2009, the EPA consulted informally with many major associations representing equipment manufacturers and suppliers, construction contractors, consulting engineers, and water and wastewater utilities, and performed targeted interviews with several well-established water infrastructure contractors and firms who work in a variety of project sizes, and regional and demographic settings to ask the following questions:

- What percentage of total project costs were consumables or incidental costs?

- What percentage of materials costs were consumables or incidental costs?

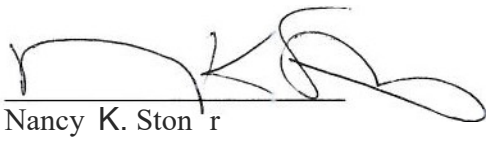
- Did these percentages vary by type of project (drinking water vs. wastewater treatment plant vs. pipe)?

The responses were consistent across the variety of settings and project types, and indicated that the percentage of total costs for drinking water or wastewater infrastructure projects represented by these incidental components is generally not in excess of 5 percent of the total cost of the materials used in and incorporated into a project. In drafting this waiver, the EPA has considered the de minimis proportion of project costs generally represented by each individual type of these incidental components within the many types of such components comprising those percentages, the fact that these types of incidental components are obtained by contractors in many different ways from many different sources, and the disproportionate cost and delay that would be imposed on projects if the EPA did not issue this waiver.

Assistance recipients who wish to use this waiver should in consultation with their contractors determine the items to be covered by this waiver and must retain relevant documentation (i.e., invoices) as to those items in their project files.

If you have any questions concerning the contents of this memorandum, please contact Timothy Connor, Chemical Engineer, Municipal Support Division, at connor.timothy@epa.gov or (202) 566-1059 or Kirsten Anderer, Environmental Engineer, Drinking Water Protection Division, at anderer.kirsten@epa.gov or (202) 564-3134.

Issued on: A?R t5 2014

Approved by: 

Nancy K. Ston r
Acting Assista t Administrator

Ohio Water Pollution Control Loan Fund

Use of American Iron and Steel - De Minimis Final Utilization and Certification Form

The Consolidated Appropriations Act of 2014 (P.L. 113-76) Section 436 requires the use of American & Steel in SRF-funded projects. Under the authority of Section 436(b)(1), the EPA has issued a public interest waiver for De Minimis incidental components. The assistance recipient wishing to use this waiver should consult with their contractor(s) to maintain an itemized list of components covered under De Minimis. At the conclusion of the project, this form must be completed and retained in the assistance recipient's project files and a copy provided to DEFA. Please print clearly or type.

Project Name:_____ Loan Agrmt #: _____

NOTE: The De Minimis waiver is only applicable to the cost of materials for the entire project. Do not include other project costs (labor, installation costs, etc.) in the "Total Cost of Materials". The cost of a material must include delivery to the site and any applicable tax. Must have sufficient documentation to support all costs included in this calculation.

Funds used for de minimis incidental components cumulatively may comprise no more than a total of 5 percent of the total cost of the materials used in and incorporated into a project; the cost of an individual item may not exceed 1 percent of the total cost of the materials used in and incorporated into a project.

Total Cost of Materials: _____ 5% Limit: _____ 1% limit: _____

Manufacturer & Component Description	Part/Model #	Quantity (if applicable)	Cost per Unit (if applicable)	Component's Total Cost	How is Cost Documented?*

Use additional sheets as necessary **Total De Minimis Cost of Components:**

If approaching the 5% or 1% limits, contact DEFA immediately

* Documentation must demonstrate confirmation of the components' actual costs (invoice, etc.).

Completed by:

Name: _____ Title: _____

Signature: _____ Date: _____

Violating Facilities:

The Contractor agrees to comply with all applicable standards, orders or requirements under Section 306 of the Clean Air Act, 42 USC 1857 (h), Section 508 of the Clean Water Act, 33 USC 1368, Executive Order 11738, and EPA regulations, 40 CFR Part 32, which prohibits the use under non-exempt Federal contracts, grants, or loans of facilities included on the EPA List of Violating Facilities.

Requirement For Utilization Of Small Businesses In Rural Areas (SBRA)

This procurement is subject to the EPA policy of encouraging the participation of small businesses in rural areas. It is EPA policy that recipients of EPA financial assistance awards utilize the services of small businesses in rural areas (SBRAs), to the maximum extent practicable. The objective is to assure that such small business entities are afforded the maximum practicable opportunity to participate as subcontractors, suppliers and otherwise in EPA-awarded financial assistance programs. This policy applies to all contracts and subcontracts for supplies, construction, and services under EPA grants or cooperative agreements. Small purchases are also subject to this policy.

Supplemental Insurance Provisions

The Contractor shall, at their expense, furnish and maintain insurance in the form and amounts specified in subparagraphs 1 through 7 inclusive, of this section. Policies shall be with acceptable insurance companies authorized to do business in the State of Ohio.

The Contractor shall not commence Work nor shall he permit any of his Sub-contractors to commence Work until the insurance policies specified hereinafter, or otherwise required, have been submitted to, and approved by the Owner. Such insurance policies shall be kept in force until the Contractor receives final payment.

Insurance shall be endorsed so that it cannot be changed or canceled in less than ten (10) days after receipt by the Contractor and the Owner of written notice of such proposed action from the Insurer.

The insurance specified in Subparagraphs 1, 2, 3 and 4 shall be written under the comprehensive general form of liability insurance contracts.

The Contractor shall furnish three (3) certificates or, whenever specifically requested by the Owner, three (3) certified copies of the insurance policies themselves and a receipt evidencing full payment of the premiums.

In addition to the insurance described hereinafter, the Contractor shall secure and maintain such other insurance as may be designated elsewhere in the Contract document.

If the Contractor is required to repair or perform Work after the completion of the Work involved under this Contract or obtain new policies in accordance with the requirements in this section.

1. *Builders Risk*: In addition to such fire and other physical damage insurance as the Contractor elects to carry for his own protection, he shall also secure and maintain in the name of the Owner, the government agency sponsoring the Project, Subcontractors, the Consulting Engineer and any other parties having an interest in the Project, as named insured as their interest may appear; a builders' risk policy for fire, extended coverage, vandalism and malicious mischief in the amount of one hundred (100) percent of the value of the complete parts of the Project and Materials in storage, except that such coverage shall not be required in connection with sewer, water main or paving construction. Pump or lift station construction shall not be considered sewer or water main construction for purposes of this paragraph.

2. *Workers Compensation*: The Contractor shall provide Workers Compensation Insurance for all employees engaged in Work who may come within the protection of the workers compensation law, and, where applicable, employer's General Liability Insurances for employees not so protected and shall require all Subcontractors to provide corresponding insurance.

The Contractor shall indemnify the Owner and the Consulting Engineer against any and all liabilities, cost and expenses due to accidents or other occurrences covered by the workers compensation law.

3. *Contractor's Motor Vehicle Bodily Injury and Property Damage Liability Insurance*: Insurance to cover liability arising from the use and operation of motor vehicles in connection with the performance of the Contract (as customarily defined in liability insurance policies), whether they be owned, hired or non-owned by the Contractor, as follows:

a. Bodily Injury Liability: $500,000 for each person; limit of $1,000,000 for each occurrence.

b. Property Damage Liability: $500,000 for each occurrence.

4. *Contractor's Public Liability and Property Damage Liability Insurance*: Contractor's Public Liability Insurance providing a limit of not less than $500,000 for all damages arising out of bodily injuries, including accidental death to one person, and a total limit of $1,000,000 for all damages arising out of bodily injuries, including accidental death, to two or more persons in any one occurrence. Contractor's Property Damage Liability Insurance providing for a limit on not less than $500,000 for all damages to or destruction of property.

Coverage under this policy shall include, to the limits indicated above, the collapse or damage to any structure, building or its contents, public or private utility, or pavement during construction and for two (2) years thereafter.

Whenever Work under the Contract is to be done in the vicinity of existing underground utilities or structures, coverage under the policy shall also include, to the limits indicated, all damages to said underground utilities or structures during construction and for a period of two (2) years thereafter. Whenever Work under the Contract is to be done by blasting, coverage under the policy shall also include, to the limits indicated above, all damages of any kind whatsoever caused by blasting.

5. *Contractor's Protective Public Liability and Property Damage Liability Insurance*: Contractor's Protective Public Liability and Property Damage Liability Insurance for operations performed by Subcontractors providing for coverage and limits corresponding to those described in subparagraph 4.

6. *Owner's Protective Public Liability and Property Damage Liability Insurance*: Regular Owner's Protective Public Liability and Property Damage Liability Insurance for operations performed by the Contractor or any Sub-contractor providing for coverage and limits corresponding to those described in subparagraph 4.

This policy shall be written in the name of the Owner as a separate policy from those specified elsewhere herein.

7. *Railroad Protective Liability Insurance*: In any of the Work under this Contract is on railroad R/W, the Contractor shall at its sole cost and expense, procure and provide, for and in behalf of each railroad company. Protective Liability Insurance (AARAASHO form) with minimum limits per occurrence of not less than $2,000,000 for bodily injury, death and/or property damage, subject to an aggregate limit of $6,000,000 per annum. The policy shall name each railroad company as the insured and be issued to the Contractor. Each railroad company shall be provided with a copy of each policy of insurance prior to commencement of any work.

Materials Testing

Testing Services

1. Contractor shall appoint, employ, and pay for specified services of an independent firm to perform testing.

2. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer.

3. Testing and source quality control may occur on or off the project site. Perform offsite testing as required by the Architect/Engineer or the Owner.

4. Reports will be submitted by the independent firm to the Architect/Engineer and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

5. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

a. Notify Architect/Engineer and independent firm 24 hours prior to expected time for operations requiring services.

b. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

6. Testing does not relieve Contractor to perform Work to contract requirements.

7. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.

Continuous Treatment Provisions

Continuous Treatment (wastewater projects)

Federal regulations prohibit by-passing of any sewage during construction operations. The Contractor will be responsible for providing any required temporary pumping facilities piping, etc., necessary to complete the project without any plant by-passing and continuous treatment must be provided at the same level during construction as existed prior to construction.

Unless otherwise previously or subsequently specified, the Contractor shall procure and pay for all permits, licenses, and approvals necessary for the execution of his Contract.

The Contractor shall comply with all laws, ordinances, rules, orders, and regulations relating to the performance of the work required to complete their Contract.

The following example language is a sample of what might be appropriate for construction work occurring at an existing drinking water treatment plant. The language actually incorporated into the contract documents must be adjusted to meet the specifics of the construction project.

Continuous Treatment (drinking water projects)

The Contractor will be responsible for obtaining approval from Ohio EPA for use of temporary pumping facilities, piping and other items in order to complete the project without any plant by-passing. Continuous treatment must be provided at the same level during construction as existed prior to construction.

Unless otherwise previously or subsequently specified, the Contractor shall procure and pay for all permits, licenses, and approvals necessary for the execution of his Contract.

The Contractor shall comply with all laws, ordinances, rules, orders, and regulations relating to the performance of the work required to complete their Contract.

State of Ohio

WATER SUPPLY REVOLVING LOAN ACCOUNT (or DWAF)

CONTRACT CHANGE ORDER

RECIPIENT_____ CHANGE ORDER NBR _____

LOAN NUMBER_____ CONTRACT _____

OWDA PROJECT No. _____ DATE _____

Description of Change:

The time provided for completion in the contract for the above items is (increased/decreased) by ____ calendar days.

RECOMMENDED BY: _____ DATE: _____
(Engineer)

APPROVED BY: _____ DATE: _____
(Recipient)

ACCEPTED BY: _____ DATE: _____
(Contractor)

_____
(Company)

Original Contract Amt		
Previous Changes (+ / --)		
This Change (+ / --)		
Adjusted Contract Amt		

OWDA APPROVAL

The above proposal is hereby accepted and I recommend that it be approved and made a part of the contract noted above. The approval does not constitute an increase in the total loan amount, but represents approval for the work.

Ohio EPA Acceptance

Date

Chief Engineer

Date

CHANGE ORDER INSTRUCTIONS:

All Change Orders for this work, regardless of costs and whether Water Pollution Control Loan Fund (WPCLF) or Water Supply Revolving Loan Account (WSRLA) funding will be used to finance the changes, must be submitted to Ohio EPA for review.

Changes Requiring Prior Approval

Any change which substantially modifies the Project Facilities as specified in the Ohio EPA approved Facilities Plan and Final Permit to Install or Final Plan Approval (when applicable) or alters the direct or indirect impact of the Project Facilities upon the environment must be incorporated into a Change Order. One copy of the Change Order prior to execution is to be submitted to Ohio EPA for review and prior approval of the acceptability of the change. "Prior to execution" means before the Change Order is signed by the Owner.

Ohio EPA will review the Change Order and inform the Owner of the technical, environmental and operational acceptability of the change, and give the Owner permission to proceed with the proposed work.

All Other Changes

Change Orders not requiring prior approval as described above must be submitted to Ohio EPA within one (1) month of the time at which they are approved by the Owner. Change Orders for WPCLF projects should be submitted to the Division of Environmental and Financial Assistance (DEFA) while Change Orders for WSRLA projects should be submitted to the Division of Drinking and Ground Water (DDAGW) in central office.

Change Order Approval Process

After the Change Order is executed, one (1) copy of the Change Order, including the supporting documentation, is to be sent to Ohio EPA for final review. The WPCLF/WSRLA Change Order forms must have original signatures.

Communities have the option to submit hard copies of the project Change Orders via mail to Ohio EPA or to send PDF Change Order forms and supporting documentation electronically. With either hard copy or electronic submittals, the WPCLF Change Orders should be submitted to DEFA and WSRLA Change Orders should be submitted to DDAGW - Central Office.

The dedicated e-mail address for the electronic submittal of WPCLF Change Orders is EPAWPCLFCO@epa.ohio.gov.

The dedicated e-mail address for the electronic submittal of WSRLA Change Orders is EPAWSRLACO@epa.ohio.gov.

After the Change Order is accepted and eligible costs determined, Ohio EPA will issue a letter informing the Owner and authorizing OWDA to disburse funds from Project Contingency for the work. The OEPA letter will be sent electronically. OWDA will return a PDF of the WPCLF/WSRLA Change Order form which will be signed by all parties including Ohio EPA and OWDA.

Please notify Ohio EPA if the community prefers a hard copy of change order approval documentation and then Ohio EPA and OWDA will send hard copies of approval documentation through the mail.

Payments for Change Order Work

The Owner is precluded from submitting to the OWDA payment requests for Eligible Project Costs associated with the Change Orders until such time as the Ohio EPA's approval of the Change Orders has been obtained.

Local Protest Procedure

Protests

A protest based upon an alleged violation of the procurement requirement may be filed against the OWNER's procurement action by a party with an adversely affected direct financial interest. The protest shall be filed with the Mayor. The OWNER shall determine the protest. The OWNER may request additional information or a hearing in order to resolve the protest.

A protest shall be filed as early as possible during the procurement process, but must be received by the OWNER no later than one week after the basis of the protest is known or should have been known, whichever is earlier. If the protest is mailed, the protester bears the risk of non-delivery within the required time period.

A protest must clearly present the procurement requirement being protested, the facts which support the protest, and any other information necessary to support the protest.

Payment Methods

1. At least ten (10) days before each progress payment falls due (but not more often than once a month), the Contractor will submit to the Engineer a partial payment estimated filled out and signed by the Contractor covering the work performed during the period covered by the partial payment estimate and supported by such data as the Engineer may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitable stored at or near the site, the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the Owner as will establish the Owner's title to the material and equipment and protect his interest therein, including applicable insurance. The Engineer will, with ten (10) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the Owner, or return the partial payment estimate to the Contractor indicating in writing his reason for refusing to approve payment.

   In the latter case, the Contractor may make the necessary corrections and resubmit the partial payment estimate. The Owner will, within 30 days of presentation to him of an approved partial payment estimate, pay Contractor for labor performed and material incorporated in the Work, at the rate of 92 percent of the amount of the estimate as approved by the Engineer until 50 percent of the Work is completed. All labor performed and material incorporated in the Work after the job is 50 percent of completed shall be paid for at the rate of 100 percent of the amount of additional labor and material furnished and approved and the amount labor and material furnished and approved the amount previously retained shall be deposited in an escrow account. The funds in the escrow account with accumulated interest are to be paid the Contractor at the same time and in the same manner as specified for payment of the of the retained amount in Section 5.

   Payment for material and equipment delivered and not incorporated shall be based on the scheduled of quantities and cost submitted. Any money due from Owner shall, on the day that it is due, be paid to Contractor, or deposited in an escrow account, whichever is applicable, with one or mare banks or building and loan associations in the state selected by mutual agreement between the Contractor and the Owner. The agreement shall contain the following provisions:

   A. The money shall be deposited in a savings account or the escrow agent shall property invest the entire escrow principal in obligations selected by the escrow agent, as stipulated in the agreement.

   B. The escrow agent shall hold the escrow principal and income until receipt of notice from the Owner and the Contractor, of until receipt of an arbitration order specifying the amount of escrow principal to be released and the person to whom it is to be released. Upon receipt of the notice or order, the agent shall properly pay such amount of principal and the portion of amount of the escrow income to the person indicated.

   C. The escrow agent shall be compensated for its services as agreed to by the Owner and the Contractor from the income from the escrow account.

2. The request for payment may also include an allowance for the cost of such major material and equipment which are suitably stored either at the site or the near the site.

City of Canton, Ohio
Water Department
Sugar Creek Water Treatment Plant
& Wellfield Improvements

APPENDIX D – TABLE OF CONTENTS
Technical Specifications

Supplemental Specification 01-00

PROJECT DOCUMENTATION AND SUBMITTAL REQUIREMENTS
FOR
ALL PUBLIC WORK PROJECTS AND SUBDIVISION DEVELOPMENTS

September, 2000
* Revised May, 2017

Project Submittals: The following listed items are the full responsibility of the Contractor. These items become part of the administrative duties imposed upon this Contract. The Contractor shall be responsible for submitting all detail items prior to the contract Notice of Commencement, or as directed by the City's Project Manager. A typewritten letter shall accompany all items, on Company letterhead; clearly describe each item submitted. If Contractor elects to fax any documentation due to expediency, the Contractor will be responsible for submitting hard copy for project documentation. The City will reject any information not clearly legible.

The City will not pay directly for the performance of the work listed. This work is a subsidiary obligation of the Contractor.

1. Preconstruction Video
2. Statements of Final Compliance

1. **Preconstruction Video:** Prior to actual construction, the Contractor shall take video recording of the entire length and width of the work site.
   a) The Contractor shall notify the Engineering Department prior to scheduling the video recording of the site. A representative of the Engineering Department shall be present when the recording this video.
   b) The video and audio recordings shall be on DVD or pre-approved alternative for replay. Contractor must submit alternative medium to the Engineer and approval received prior to scheduling.
   c) The video portion shall have continuous time and date incorporated into it, locations and person(s) doing the work.
   d) Audio comments during the recording must address each item in the field of view as it may pertain to the project construction. The recording technician will need to become familiar with the project plans to know what subject matter is pertinent. Further, contractor must incorporate a post recording review and audio comments into the recording.
   e) Submitted copies of all recordings are the property of the Engineer. Contractor must submit the recording and be accepted in full by the Engineering Department prior to the start of construction.

2. **Statements of Final Compliance:** The Contractor shall submit to the City the following documentation, in addition to the Project's General Conditions. All submittals shall be completed and approved prior to the release of the final retainer.

a) Certificates of Substantial and Final Completion. Contractor shall submit in writing, the date on which work is substantially completed and upon Final Completion. Any deviation from the stated contract completion date to what is being submitted shall be explained further by the Contractor. The City, at their discretion, will further review this subject, as needed.

b) Final Waiver of Lien
Contractor shall furnish a written report indicating the resolution of any and all property damage claims filed with Contractor by any party during the contract period. The information shall include the name of claimant; date filed with Contractor; name of Insurance Company and/or Adjustor handling the claim; how the claim was resolved; if claim was not resolved for the full amount, a statement indicating the reason for such action. If there were no damage claims filed with the Contractor, then this shall be so stated in the report.

SECTION 01 00 00

GENERAL REQUIREMENTS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Description.** The Contractor shall provide the labor, tools, equipment, and materials necessary to complete the work as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with current applicable requirements of governing agencies having jurisdiction.

B. **Testing Laboratory.** The Owner shall engage with a testing laboratory to perform inspection and tests when required. The Contractor is responsible for scheduling and coordinating with the Owner's testing laboratory.

1.4 SUBMITTALS

A. **General.** Furnish samples, manufacturer's product data, test reports, and material certifications as required for materials and mix design when required.

B. **Notification**. The Contractor shall give the Engineer and the Owner 72 hours notice (excluding Saturdays, Sundays, and legal holidays) as to when the actual construction is to begin so that all affected parties may be notified.

1.5 JOB CONDITIONS

A. **Confine operations to areas** within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed. Limit use of the premises to construction activities in areas indicated.

B. **Keep driveways and entrances clear** and available to the property Owner at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. **Burial of Waste Materials**. Waste materials shall not be buried within the project site.

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS (Not applicable)

PART 3 EXECUTION

3.1 CONSTRUCTION COORDINATION

A. The Contractor will coordinate the construction scheduling and construction activities with the Engineer and the Owner.

3.2 CONSTRUCTION SCHEDULING

A. The Contractor will be required to submit to the Engineer, in writing, his proposed construction sequences for the project. No construction shall commence until review of the Contractor's proposal by the Engineer. Approval will be given for proposed sequences only and shall not cause the Engineer or Owner to accept any responsibility for the actual work in progress. Coordinate with requirements in Section 01 11 00 and 01 14 00.

3.3 PERMITS

A. It shall be the Contractor's responsibility to pay for and obtain all permits, including any necessary building, plumbing, and excavating permits. All permit costs and fees including construction deposits shall be borne by each Contractor.

3.4 SAFETY

A. Safety requirements shall be in accordance with the General Conditions and the Occupational Safety and Health Act of 1970, U.S. Department of Labor. The Contractor is required to provide additional provisions for the safety of children in areas of work. These provisions require that the work area shall be fenced; and open excavations, open manholes or similar hazards shall not be left unattended. Excavations shall be secured at night and all equipment and supplies moved to a secured area.

3.5 ACCESS TO FACILITIES

A. The Contractor shall minimize the amount of ground area required for its equipment. The Contractor shall not obstruct access to buildings, obstruct normal operations, and shall maintain traffic at all times.

3.6 PROTECTION OF FACILITIES

A. The Contractor shall exercise extreme caution within and adjacent to its work areas so as not to damage existing facilities. The Contractor shall assume all responsibility for the protection of any existing facility to remain in service. Any facilities that are damaged due to the Contractor's operations shall be repaired or replaced by the Contractor to original condition at no expense to the Owner.

3.7 PROTECTION OF TREES

A. Special attention shall be given to the trees which exist in the proximity of the proposed construction. The Contractor shall provide the labor, tools, equipment, and materials necessary to protect the integrity of each tree from damage during the performance of the contracted work. Any trees that are damaged because of the Contractor's operations shall be repaired or replaced at no expense to the Owner by the Contractor and to the satisfaction of the Engineer and the Owner.

3.8 NOISE, DUST, AND ODOR CONTROL

A. The Contractor's construction activities shall be conducted to minimize all unnecessary noise, dust, and odors. The use of oil or other materials which may cause tracking shall not be permitted.

3.9 UTILITIES

A. **Temporary Lighting and Construction Power**. The Contractor shall make arrangements with the electric power company to receive temporary lighting and

construction power system at the construction site. Such system shall meet all requirements of the NEC, or any other state and local codes for temporary construction services. The temporary construction power system shall be a separately metered service derived from the utility and until final acceptance shall be paid for by the Contractor. The permanent power shall be installed prior to start-up, and final acceptance of all improvements. The Contractor shall be responsible to install and remove any temporary power required during construction.

B. **Water**. The Contractor shall make its own arrangements to have water at the construction site for any required use. All costs for having water at the construction site shall be paid by the Contractor.

C. **Sanitary Facilities**. Suitable facilities for the use of all persons employed on the construction site shall be provided, maintained, and paid for by each Contractor. The sanitary conveniences shall be properly screened from public observation. The Contractor shall obey and enforce such other sanitary regulations and orders and shall take such precautions against infectious diseases as may be deemed necessary by the Engineer and/or the Owner.

D. **Internet and Cell Service**. The Contractor shall make its own arrangements to have adequate internet and cell service for staff and subcontractors until completion of the Contract.

E. **Fuel**. The Contractor shall make its own arrangements to have fuel at the construction site for any required use. All costs for having fuel at the construction site shall be paid by the Contractor.

3.10 CLEAN-UP

A. All debris rubble, unusable materials and items not salvaged shall become the property of the Contractor and shall be removed from the site.

3.11 SITE REPAIR

A. The Contractor shall be responsible for restoring to its previous condition all site areas damaged during construction.

3.12 PRESERVATION OF PROPERTY CORNERS AND SURVEY MARKERS

A. The Contractor shall preserve all cornerstones, iron pins, monuments, or any other type of land monument. He shall have all land monuments in the proximity of the work referenced. He shall replace destroyed or damaged monuments and shall furnish a certification by a registered surveyor that the monuments have been restored.

END OF SECTION

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide all labor, materials, tools, and equipment necessary to construct the project in accordance with the plans and as specified herein. The Contractor shall be responsible for the scheduling and coordination to provide a complete project for the Owner. The Contractor shall provide the overall general coordination and a complete project schedule that includes coordination with Subcontractors. Please review specification Section 01 14 00, Work Restrictions for additional information and requirements.

B. **Summary of Work.** The Contract can be summarized as follows:

1. Wellfield general construction includes civil and structural construction plus other activities traditionally recognized as general construction. It also includes administrative and coordination responsibilities. Work includes but is not limited to:

   a. General requirements including submittals; temporary construction facilities and utilities, unless specifically identified to be supplied by others; staging area as shown on the plans; testing and disinfection; start-up and commissioning; and project coordination with subcontractors and scheduling.

   b. Site work including demolition, cutting, and patching; clearing and grubbing; site dewatering; excavation support systems; compacted backfill and compacted granular backfill; site excavation, backfill, and embankment; compacted foundation; erosion control during construction; protection of existing vegetation; driveways; parking areas; sidewalks; underground piping, valves, fittings, appurtenances, and connections to existing; site irrigation; and landscaping.

   c. Cast-in-place concrete, precast concrete, and grouting.

   d. Modifications to ten existing well pumps, inner and outer casing pipes, removal of valve vaults and piping, and cutting down the heights of the casing pipes, and providing new plates for mounting the pumps to the lowered casing pipe, and constructing new pump discharge piping and valves at the location shown on the drawing, providing a metal building and foundations to house motor controls, piping, valves, instruments and controls, and reconnecting each to the existing and new raw water transmission mains. Wells #8, #9 and #10 include installation of

new x-bracing casing support systems with concrete foundations as show on the plans.

e. Maintenance of Traffic.

f. Installation of a new raw water transmission main, valves, and appurtenances which is generally parallel to the existing raw water transmission main. Refer to the Scope of Bids document for additional details of responsibilities for the General Contractor, Pump Service Company, and Electrical Contractor. The quote from the Pump Service Company is provided as Appendix IV.

g. Installation of combination air valves, access valves, air vacuum relief valves, chambers, and other appurtenances, where shown on the drawings.

h. Site safety.

i. Layout and surveying.

j. Demolition as described in the Contract documents.

2. Water Treatment Plant Construction includes architectural, civil, mechanical, and structural construction plus other activities traditionally recognized as general construction. It also includes administrative and coordination responsibilities. Work includes but is not limited to:

a. General requirements including submittals; temporary construction facilities and utilities, unless specifically identified to be supplied by others; staging area as shown on the plans; construction facilities for the Engineer; project plaque; testing, adjusting, balancing, and disinfection; start-up and commissioning; and project coordination.

b. Site work including demolition, cutting, and patching; clearing and grubbing; site dewatering; excavation support systems; compacted backfill and compacted granular backfill; site excavation, backfill, and embankment; compacted foundation; erosion control during construction; protection of existing vegetation; driveways; parking areas; sidewalks; underground piping, valves, fittings, appurtenances, and connections (outside storm, sanitary, water and gas piping to 5 feet from buildings); site irrigation; chain link fence; and landscaping.

c. The work in the plant shall include :

1. Both the East and West Aerator Building improvements including, but not limited to, new piping, valves, roof hatches, ladders, plumbing, heating, instrumentation, controls, and electrical work. Rehabilitation work at both buildings includes, but not limited to, aerator trays, concrete repairs, masonry repairs, and refurbishment of existing screens and framing. The West Aerator Building requires replacement of the existing roof with new precast roof deck.

2. Pipe Gallery improvements including influent header, backwash supply, new piping, valve replacement, new air scour mains, Filter-to-Waste pump, plumbing, dehumidification, heating and ventilation, plumbing, I&C, and electrical work.

3. Refurbish twelve (12) filters including media removal, underdrain cleaning, installation of air scour system, new windows and doors in Filter Gallery, handrails, access hatches and ladders, painting, ventilation and heating instrumentation, controls, and electrical work.

4. High Service Pumps discharge piping and valves will be replaced for all pumps. Pumps #2 - #5 will have new pump heads and rebuilt. Motors on Pumps #3 through #5 will be cleaned, refurbished, and reinstalled with new motor bases. Install new motor and variable frequency drive (VFD) on Pump #2. A new magnetic flow meter will be installed on the finished water header to meter plant flows. A surge relief blowoff valve on the finished water header will be added to minimize water hammer in the transmission main on loss of power. Refer to the Scope of Bids for description of the responsibilities for the General Contractor, Pump Service Company, and Electrical Contractor. The quote from the Pump Service Company is provided as Appendix IV.

5. The three (3) clearwells will be modified to improve operational flexibility to be able to isolate any one of the clearwells. New Chlorine Contract Tanks will be constructed by installing new concrete partition walls. A FRP baffle system will be installed in the clearwells and Chlorine Contact Tanks to improve flow patterns and mixing in the tanks.

6. The existing Clearwells, Chlorine Contact Tank, and the High Service Pump Clearwells will be cleaned and the sediment removed prior to being returned to service. The Backwash Makeup Reservoir will be cleaned and inspected. A new drain will be installed.

7. All storm drainage will be separated and re-directed to a local stormwater drainage channel.

8. Building renovations include aintenance Garage, Fluoride, and Chlorine Handling Buildings. Remodeling the lobby including a new LULA elevator and second floor offices, lab, control room, and restrooms. The glass block window wall and lobby will be replaced with a curtainwall system. A new restroom will be added to the first floor.

9. The existing chlorinators and solution distributors will be replaced, and new piping installed to two new Chlorine Contract Tanks.

10. The existing 2,500-gallon underground fuel oil tank will be removed and a new 3,000-gallon above ground tank installed.

11. A new Dechlorination Building will house chemical system to feed sodium bisulfite to the backwash lagoon effluent.

d. Cast-in-place concrete, precast concrete, and grouting.

e. Masonry and glass unit masonry.

f. Miscellaneous metals; structural steel; and FRP items.

g. Rough Carpentry.

h. Roofing and flashing; caulking. See Appendix II, "Lead and Asbestos Survey Reports." The Contractor responsible for demolition, renovation, and disposal of roofing and flashing material must adhere to all EPA regulations and OSHA, 29 CFR 1926.1101.

i. Aluminum doors and frames; windows; floor doors; overhead aluminum coiling doors; unit skylights, and finish hardware.

j. Finishes; concrete waterproofing; painting, and special coating.

k. Signs, fire equipment, and other specialties.

l. Division 41, Material Processing and Handling Equipment.

m. Division 43, Process Gas and Liquid Handling, Purification and Storage Equipment.

n. Division 44, Pollution and Waste Control Equipment.

o. Division 46, Water and Wastewater Treatment Equipment

p. Process piping, fittings, accessories, valves, and gates; mechanical pipe seals and wall castings for piping.

q. Installation of instrumentation equipment supplied under the Electrical Contract as specified in Division 40, Process integration, which is to be installed directly in any plant piping or mounted to or inside structures.

r. Site safety..

s. Layout and surveying for General Contract work.

t. Demolition as described in the Contract documents..

u. Lead and asbestos abatement removal and disposal as required by Contract Documents. Refer to the Lead and Asbestos Survey Results provided in Appendix II.

v. The Contactor shall clean all tanks and channels that include both aeration buildings, clearwells, high service pump chambers, chlorination channel, any tanks scheduled for new work or renovation as detailed in Contract Documents. The Owner will drain the tank. Solids in the tank bottom may be removed by the

Contractor and disposed of off- site at an approved location. The Contractor shall submit a plan for cleaning the tanks to the Owner for approval before cleaning work begins.

3. Plumbing work includes but is not limited to:

   a. All piping and plumbing under Division 22; supports and anchors; mechanical identification; mechanical insulation; water plumbing system; drainage and vent system; plumbing fixtures; fire protection; plumbing pumps; and Plumbing control wiring between Plumbing equipment and controls.

   b. Site safety for Plumbing work.

   c. Layout and surveying for Plumbing work.

4. HVAC work includes but is not limited to:

   a. All HVAC under Division 23; supports and anchors; mechanical identification; mechanical insulation; breechings, vents, and stacks; indirect fired units; self-contained air conditioners; dehumidification units; power ventilators; metal ductwork; ductwork accessories; air outlets and inlets; and HVAC control wiring between HVAC equipment and controls.

   b. Site safety for HVAC Contract work.

   c. Layout and surveying for HVAC Contract work.

5. Electrical work includes electric power distribution, MCCs, VFDs, Panels, Local PLC panels, power, control, lighting, instrumentation, controls, SCADA hardware and software, CCTV security systems, telecommunication systems and includes but is not limited to:

   a. General requirements including submittals; temporary construction facilities for electrical work; testing; start-up and commissioning; temporary electrical power; and project coordination.

   b. Electrical site work including demolition, cutting, and patching; site dewatering for Electrical work; excavation support systems for Electrical work; compacted backfill and compacted granular backfill for Electrical work; and site excavation, backfill, and embankment for Electrical work.

   c. Cast-in-place concrete, precast concrete, and grouting for Electrical work including equipment pads, reinforcing steel, and anchor bolts.

   d. Division 26 electrical, including ductbanks, conduit, wiring, fiber optic cabling, including boxes, devices, supports, and hangers.

   e. Instrumentation equipment as specified in Division 40, Process Integration, Section 40 90 00 through Section 40 95 33.06, including installation.

   f. HVAC control wiring between HVAC systems and Instrumentation systems.

g. Plumbing control wiring between Plumbing systems and Instrumentation systems.

h. Site safety for Electrical work.

i. Layout and surveying for Electrical work.

j. Power connections to terminate wiring to equipment furnished.

k. Telecommunications systems including telephone distribution systems and fiber-optic cable.

l. SCADA system and CCTV security system, including all hardware software, servers, conduit, wiring, and communications systems.

m. Demolition of electrical items as described in the Contract documents.

C. QUALITY ASSURANCE

1. **Codes and Standards**. Perform all work in compliance with current applicable requirements of governing agencies having jurisdiction.

2. **Special Inspections During Construction.** The Owner will engage a third party testing agency for special inspections during construction, which requires certification by the state for quality conformance. The Contractor is responsible for scheduling and coordinating all testing services which are defined on Sheet SD-10.

3. **Additional Testing.** The Contractor is responsible for the scheduling, coordination, and payment of all additional testing explained in the Contract documents. This includes but is not limited to disinfection testing, leakage testing, pressure testing, startup of equipment, televising, arc flash report etc.

1.3 PERMITS

A. **Ohio EPA**. A Water Supply Data Sheet and associated documentation has been approved by the Ohio EPA Division of Drinking Water. A copy of the Approved Documents are available to the Contractor.

1. The Notice of Intent (NOI) Permit has been completed and purchased prior to receiving bids. The Contractor will be designated as a co-permittee by the Owner through the OEPA online eBusiness Center Portal.

B. **Building Department.** Plan approval has been received from East Central Ohio Building Authority. Contractor shall post approved drawing on the job site with manufacturer's installation instructions and product information, and shall be available for use by the inspector in accordance with OBC 107.7. All inspections will be subject to the East Central Ohio Building Authority where applicable. The Contractor shall contact the appropriate inspector to schedule the inspections at least one day prior to the required inspection. Each missed, incomplete or non-compliant inspection may be charged a re-inspection fee of $150. The Contractor is responsible for all associated fees.

1. Building and mechanical inspections: Bob Thompson (330) 401-8528

2. Electrical Inspections: Tom Stephens (330) 418-8318

3. Plumbing, Elevator and Medical Gas inspections are conducted by Ohio Department of Commerce DIC (800) 822-3208.

1.4 SUBMITTALS

A. **Submittal Requirements**. See other Division 1 sections for required administrative submittals and for procedures necessary for transmittal of submittals.

1.5 JOB CONDITIONS

A. **Contractor shall maintain** continuous treatment of water, with the exception of scheduled outages where they are approved and coordinated with the Owner/Engineer. Contractor shall follow provisions in Section 01 14 01 Work Restrictions, and no outage shall be permitted that is not submitted for review and approved by the Owner and Engineer at least 72 hours in advance.

B. **Confine operations to areas** within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed. Limit use of the premises to construction activities in areas indicated. Work shall be confined to public rights-of-way and easements.

C. **Keep driveways and entrances clear** and available to the property Owner at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

D. **Burial of Waste Materials**. Waste materials shall not be buried within the project site.

E. **Security**. The Contractor shall be responsible for site security.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Material.** Material delivery and storage locations shall be coordinated with the Owner. Storage and handling of materials and equipment shall be per manufacturer's requirements.

1.7 SPECIAL WARRANTY

A. **Warranty Requirements.** Provide as specified.

1.8

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 REQUIREMENTS

A. **Coordination.** A detailed schedule shall be submitted and reviewed prior to the start of construction.

B. **National Sanitation Foundation (NSF) 61.** All materials in contact with water shall meet NSF Standard 61, as required by Ohio Administrative Code (AC) Rule 3745-83-01(D).

C. **Equipment Selection and Shop Drawing Submittal.** Submit shop drawings and manufacturer's data sheets for all equipment, materials, tests, samples, and O&M manuals in a timely process. Equipment selection for selected items shall be

made at time of bid per the Manufacturers of Materials and Equipment to be Furnished Section submitted with the bid documents.

D. Clean-up.

1. Refer to Section 01 74 23 for additional requirements.
2. All construction debris and construction related materials shall be removed from the site by the Contractor.
3. All temporary power, water, bypass pumps, piping, fencing, and bulkheads shall be removed when construction is complete.
4. All trailers, tool boxes, and equipment shall be removed from the site when construction is complete to allow final grading paving, grading, planting, and seeding to be completed.
5. Collection, storing, hauling, and disposing of spoil, silt, and waste materials from excavation or any other construction activity as required by Contract Documents and in compliance with all applicable rules and regulations.

E. Walk down and Punch List.

1. Conduct walk down of all work areas with Engineer, and compile punch list of repairs and corrections of defects.
2. Substantial Completion within 28 months of Notice to Proceed.
3. Complete installation of all piping and leak test all piping
4. Make final terminations to equipment and panels. Calibrate all instrumentation and control systems and panels.
5. Commence automatic operations of equipment in all areas.
6. Conduct performance tests of all equipment to demonstrate.
7. Complete training on all equipment, including electrical system, instrumentation, Local/Remote operation of process I&Cs, and SCADA system operation.
8. Commence with making final corrections and adjustments included on punch list provide.
9. Provide all O&M manuals, redline drawings, spare part inventory list, and warranty information.

F. Final Acceptance within 30 months of Notice to Proceed.

1. Complete all repairs included on Punch List.
2. Complete submission of all project closeout documentation.

END OF SECTION

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, materials, tools, and equipment necessary, temporary or permanent, required to construct the project and improvements in accordance with the drawings and specifications, including the work restrictions specified herein. Work shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the public and to the operation and maintenance of the City's existing facilities and pipelines.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS

A. **Written Notice**. Prior to any cut-in, the Contractor shall submit written notice to the Engineer/Architect 72 hours in advance, requesting consent to proceed with cutting, including:

1. Identification of project.
2. Description of affected work and work areas of the facility.
3. Effect on other work and on structural integrity and safety of the project.
4. Description of the proposed work including:
    a. Scope of connection.
    b. Contractor and trades to execute work.
    c. Products proposed to be used.
    d. Extent of refinishing.
    e. Schedule of operations including required downtime for any of the Owner's facilities, starting time, duration, and completion.
5. Signed Notice. Each written notice must be signed by the Owner and Engineer/Architect prior to the start of work.
6. Utilities. All utility companies whose equipment and facilities are directly involved with the proposed work shall be notified prior to the start of work. The Contractor shall coordinate all his work with the utility companies.
7. Notification. Advise the plant operating personnel and the Owner when connection has been completed and normal operations can resume.
8. Shutdown Time. Contractor should allow for a minimum of 7-day window (float time) per shutdown when assembling connection schedule. Owner will use this window only to maintain or ensure continuous plant operation during critical operating conditions. If the

scope of the connection requires the shutdown of all or part of the facility, the Contractor shall work continuously around the clock to complete the connection and return the facility to normal operations.

B. **Construction Schedule.** The Contractor shall prepare and submit to the Engineer for approval in writing proposed schedule and overall sequence of construction and schedule for this project. No work shall occur until approval is provided by the Owner and Engineer.

C. **Construction Staging Area.** The Contractor shall prepare and submit to the Engineer a site plan showing the proposed construction staging area. No work shall occur until approval is provided by the Owner and Engineer.

1. The Contractor shall construct and maintain a construction staging area within the project site. Area developed and maintained shall be suitable in size to meet the needs of all Contractors involved with the project. Construction staging area shall be returned to original condition by the Contractor following the completion of the project unless noted otherwise by the Owner/Engineer. Returning areas to original condition shall include removal of all roadway materials, disking of soil, regrading, and seeding.

1.5 JOB CONDITIONS

A. **General Requirements**. It is imperative that existing facilities remain functional during this construction to the extent that the present facilities will not be reduced. Facilities to remain functional include the wellfield, water treatment equipment and processes, administration building, and related facilities.

1. **Occupancy.** Buildings shall maintain certificate of occupancy throughout construction.

2. **Staff Relocation.** Relocation of staff as a result of construction shall be aided by the Contractor as directed by the Owner.

B. **Shutdowns.** Work shall be scheduled to minimize shutdown of the water treatment plant. It is anticipated that the water plant and wells will be shut down for short durations during of the improvements. Scheduling of the shutdown and subsequent re-commissioning of the facilities shall be approved by the owner and the Engineer. Refer to the Submittals section for additional details.

1. Intermittent short term plant shutdowns will be considered on a case-by-case basis depending on the plant and City water treatment demands.

C. **Coordination**

1. Construction activities shall be coordinated with and scheduled to minimize interference with the normal operation of the water treatment plant facilities at Sugar Creek WTP as well as the Owner other two (2) water treatment plants.

2. The Contractor shall be responsible for coordinating and scheduling the activities of their subcontractors and utility work forces with the Owner. The following list of interconnections and sequencing requiring special coordination is provided for the Contractor's convenience. This list should not be considered complete and any omissions of interconnections or sequencing from this list shall not relieve the Contractor of his responsibility.

a. The Contractor and subcontractor shall coordinate installation of materials and equipment to not interfere with other construction activities.
b. The Contractor and subcontractor shall locate and install materials in location of concrete before the concrete is poured as shown in an approved shop drawing.
c. No extra compensation will be allowed to cover the cost of removing piping, conduit, ducts, etc., or equipment due to a lack of coordination or communication between the Contractor and their Subcontractors.
d. The Contractor shall be responsible for coordinating and scheduling all construction activity and to coordinate this work with the Owner.

D. **Specific Requirements**

1. The Contractor shall meet with the Engineer and Owner to determine which systems or facilities must be maintained in operation. Coordination is required to determine possible hours services can be interrupted.

2. The Owner shall have the authority to stop or prohibit any work which would interfere with or jeopardize the continuous and reliable operation of their system.

3. The Contractor shall make requests to the Owner 48-hours in advance for permission to work outside normal weekday business hours and on Saturdays and Sundays.

4. Contractor shall review and adhere to Owner's standards and regulations for work restrictions, including, but not limited to allowable workdays, hours, noise, dust, and daily clean-up.

5. The Contractor shall be responsible to maintain water quality and treatment during construction required by governing agencies and as detailed in the Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 GENERAL

A. The Contractor shall prepare and provide the Owner and Engineer the following products:

B. **Projected Construction Schedule.** The Contractor shall prepare a projected construction schedule in the form of a horizontal bar chart.

C. **Revised Construction Schedule.** A revised construction schedule incorporating any changes resulting from the schedule review.

D. **Updated Construction Schedule.** Updated projected construction schedule as the work progresses.

E. **Written Sequence of Construction.** An overall written sequence of construction.

F. **Proposed Methods of Construction.** The proposed methods of construction including equipment, storage of material, and disposal of excess material.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Site Verification.** The Contractor shall confirm and verify all requirements, conditions, dimensions, and time intervals prior to beginning actual construction in any given area and that the conditions have not changed since preparation, submission, and approval of the sequence of construction. If, in the Contractor's judgment, the proposed work is incompatible or incomplete, the Contractor shall notify the Owner and Engineer prior to commencing the work.

3.2 PREPARATION

A. **Safety.** All required or appropriate safety measures, methods, devices, or equipment shall be available and in place prior to beginning any construction.

B. **Permits.** All required permits and approvals shall be on-site at the time of beginning construction.

3.3 REQUIREMENTS

A. **Sequences and Interferences.** Since alterations, additions, and tie-ins are included in this work that potentially could interfere with the existing facilityfunction, the Contractor shall take any and all steps necessary to avoid this interference. The Contractor shall, in general, complete as much noninterfering work as possible before making tie-ins or switchovers. For example, when new components are to be added, they shall be installed and be made operational prior to removal of the existing components from service. This may require the Contractor to install and maintain temporary parallel components until service is restored. Such components may include installation and operation of temporary facilities as required to meet the system functions described herein. The Contractor shall be responsible to maintain water quality and treatment during construction as detailed in the Contract Documents. When avoidance of interference is impractical by the aforementioned methods, the Contractor shall take the following additional steps:

1. The Contractor shall schedule his work to minimize the time interval and/or frequency that any critical facility or component is out of service.
2. The Contractor shall coordinate all labor, materials, and equipment to be on the site at the start of a shutdown.
3. The Contractor shall work continuously (24 hours per day, 7 days per week) until service is restored.
4. The Contractor shall schedule his work to correspond with minimum demands on any system or facilities. This may include weekend or evening work.
5. The Contractor shall coordinate with and notify the Owner in writing 72 hours in advance of a shutdown so that the Owner can make the necessary preparations.

B. **Existing Units**. Operation of all existing valves, gates, and equipment required to complete the work shown in the Contract Documents shall be done by plant operating personnel.

C. **Tank & Channel Cleaning**. This work shall be performed by the Contractor under the supervision of the Owner. All liquid wastes shall be reprocessed back to the Backwash Lagoons and disposed off-site at an approved location.

D. **Disposal of Waste Excavation Material**. This work shall include the transport, delivery, and grading of excavated material from the wellfield and water treatment plant as required. Refer to the Scope of Bids document for additional details.

1. The Contractor shall have an OEPA approved disposal site available to receive the estimated remaining volume of waste excavation material. The City and the OEPA will review and approve of the Contractor's Disposal Site prior to the placement of any material.

2. Excess material that will be used for backfilling or regrading can be temporally stored at the WTP in the areas designated for stockpiling backfill material as approved by the Owner. All excess material shall be removed when construction is complete and restored to finish grade and seeded per Contract Drawings.

3.4 DEMONSTRATION

A. **Records and Responsibility.** The Contractor shall maintain all approved schedules, sequences of construction, copies of communications of all coordination, and other information as required at the construction site. A single point of coordination shall be designated in one responsible individual by the Contractor with the Owner and Engineer. .

3.5 DETAILED ACTIVITY – SUGGESTED SEQUENCE OF CONSTRUCTION

A. **General work.**

1. Provide project management including construction schedule, schedule of values, and list of submittals. Request for Information (RFIs) and submittals of all materials and equipment to be incorporated into the new work. Any changes in field conditions that affect schedule or cost, or scope must be submitted by the Contactor in writing and approved by the Owner prior to proceeding with work.

2. Mobilization/Construction Trailer Area

a. Submit a detailed work plan and schedule for review and approval prior to start of construction

b. Perform preconstruction audio-video recording of roadways, drives, walks, and structures, prior to start of any construction and submit for review by Engineer and Owner.

c. Provide temporary fence as required to secure construction, storage, and parking areas.

d. Furnish and install temporary sediment and erosion control measures.

e. Field verify locations for existing utilities in proximity to the new work, and verify location, depth, and type of connection needed for all tie-ins to existing mains.

3. Stormwater Pollution Prevention Plan (SWPP)

a. Furnish and install temporary sediment and erosion control as shown on Contract Drawings.

b. The preliminary plan, as shown on Contract Drawings, has been submitted for review to Tuscarawas Soils Agency for review, and their comments have been included in the plans. Contractor shall notify the Tuscarawas Soils Agency prior to the start of construction and at the completion of construction.

c. Maintain SWPP control measures until work in an area is complete. Any cleaning, maintenance, and repairs shall be maintained throughout the construction of the proposed improvements.

d. SWPP control measures shall be removed at completion of work and the site restored as required per Contract Documents.

B. **Wellfield work**. All tasks listed below are for the convenience of the Contractor(s) and shall include all necessary general and site work to the point of final acceptance by the Owner. The Contractor shall utilize a Pump Service Company to assist with removal of the Well #1- #10 pumps and motor, modify the well and pump casing as shown on the plans, and reinstall the pump and motor at each well. The General Contractor shall be responsible for all site work, regrading, paving, structural work, concrete foundations, new well building, piping, valves, and controls. The Electrical Contractor shall be responsible for the furnishing and installing the new 5 KV buried ductbank, disconnecting and reinstalling power to the motor, any temporary power to the maintain well operation until the 5 KV ductback is fully operational, and removal of the existing poles and overhead power lines once the new 5KV switchgear is operational. On a typical day, one (1) small well (Wells #1 through #7) and one (1) large well (Wells #8 through #10) are in operation. The owner typically rotates which small well is operating and which large well is in operation. There are no designated standby wells and wells are rotated based on which was called to start last.

1. Well #1 – (Typical for Wells #2 through #6)

a. Close existing gate valve between Wells #2 and #3 on the existing 24” raw water transmission main to isolate Wells # 1 and #2 prior to construction.

1. Wells # 3 through #6 will require closure of the valve located upstream the Well #7 connection which will shutdown Wells #1 through #6 through the existing Raw Water Forcemain. This shutdown shall be coordinated with the Owner as described herein.

b. Start construction of the New 24” Raw Water Transmission Main from Well #1 to the connection point just east of Well #6.

c. Construct the new electrical ductbank to the west of the existing Wells #1 to #6. Maintain electrical 4,160-volt power to Well Pumps #3- #10 at all times while work on Wells #1 and #2 are completed.

d. Remove Well Pump #1 motor and properly store in dry place during construction of new well.

e. Shut 12” isolation valve at existing raw water transmission main.

f. Terminate existing service at existing power pole, and if required, provide for temporary relocation of existing electrical service, transformer, motor controls, and SCADA panels to provide temporary service to well pump after construction of new well building is complete until the new 5-KV service is . operational. Remove power pole, transformer, support platform, and pump control panel when new 5-KV underground service is operational.

g. Remove Well Pump #1 head and pump column from well and store on site. Cut off the flanged outlet on the pump column for the existing pump discharge, and weld on steel closure plate.

h. Demolish the existing pump discharging piping, valves, and meter in the existing concrete valve vault. Demolish the existing concrete vault including roof, walls, and base slab and haul debris offsite.

i. Excavate and rough grade site for construction of new well building. Excess excavation shall be stored on-site at lagoon area or as directed by Owner. Final stockpile areas shall be graded and seeded.

j. Cut the existing steel outer 42” well casing and remove a section of the casing pipe to lower the pump to the elevations shown on the drawings. Furnish and weld on a new base plate for attaching the pump head. Furnish and install a new pump head adapter plate and bolt to the new outer casing base plate. Rotate pump discharge as shown on plans and re-install pump and motor.

k. Re-install the Well Pump #1 at the location shown on the drawings,

l. Furnish and install the new discharge pipe including the New 12” tee and riser pipe the extends above the floor of the well building.

m. Furnish the concrete foundation for the new well building as shown on the drawings.

n. Construct the new well building for Well Pump #1 on the concrete foundation including metal siding, roof panels, doors, hardware, and louvers.

o. Install the new discharge piping from the pump to the 12” riser pipe in the well building including pipe supports, valves, check valve, and air release valves, miscellaneous piping and accessories.

p. Complete installation of electrical power, lights, instrumentation and controls in new well building. Make temporary power connection from existing 4,160-volt service to new transformer in well building if new 5 KV service is not operational. Complete all HVAC and plumbing mechanical work as show on drawings.

q. Once the well casing, pump modifications, new piping, meters, and controls are installed to allow water to be pumped to the existing raw water main, temporary power shall be provided using the existing overhead 5 KV service. The Electrical Contractor shall relocate and reinstall the existing service mast, transformer, motor starter, and SCADA panel fed from existing overhead electrical service work until the new 5 KV service is fully operational. Once the new 5KV underground service is operational, the existing overhead service and temporary relocated panels can be removed.

r. Install the new 12" discharge pipe, fittings, and 16" butterfly valve in the new Raw Water Transmission Main. Install new pipe saddle, tap the existing PCCP pipe, and connect 16" valve and fittings to tie the new pump discharge valves, and make the connection

s. Complete final grading and construct new concrete pad at well pump and new gravel drives, sidewalks, and parking. Complete fine grading and seeding of disturbed areas.

2. Well #7

a. Cut the 12" discharge pipe from Well #7 to the south at the location shown on the plans. Perform same work as described for Wells #1 though #6 and connect to existing 12" discharge line at point shown in drawings downstream of new well building.

b. Coordinate construction of relocated tie-in to existing raw water transmission main to allow Well#7 to be connected below interconnection of the 30" and 36" mains feeding the East and West Aerator Buildings.

3. Well #8 – (Typical for Wells #8, #9, and #10)

a. Close 12" valve in existing valve vault for Well #8 to isolate well until new connection to existing 12" discharge pipe can be made downstream of new well building. This is also typical for Wells #9 and Well #10.

b. Always maintain electrical 4,160-volt power to well pumps #8-#10 while work on Wells #8 and #10 are completed. Terminate existing service at main pole for future temporary service to pump after construction of new well building is complete.

c. Construction of the new ductbank shall be completed from the Electrical Room at the Main WTP and Well #10, and the new ductback serving Wells #1 through #6 and #7 tied in as shown on the plans.

d. Remove, existing steel service platform, transformer, pump control panel and SCADA panel located on steel pump service platform and store on-site if needed to provide temporary power from the existing overhead 5 KV service so that the well can be put back in service if needed before the new 5kv service is operational.

e. Furnish and install improvements to well casing, well casing support system, pump modification. Demo existing piping in valve vault, backfill vault, construct new concrete well building foundations and erect new well building as shown on plans. Install new piping, meters, and controls from pump to the well building, and connect new discharge pipe to the existing raw water main so well can be put back in service. Once the new 5KV underground service is operational, the existing overhead service and temporary relocated panels can be removed.

f. Remove Pump No. #8 motor and store on site.

g. Demolish the existing pump discharging piping, valves, and meter in the existing concrete valve vault. Remove only the top slab, and place select backfill in tamped layers to the top of the existing structure.

h. Strip topsoil from site for well and place suitable backfill from various pipe and ductbank excavations to bring the site up to the rough grade to the limits shown on the plans.

i. Cut the existing steel outer 42” casing and remove a section of the casing pipe to the elevation shown on the plans. Furnish and install new base plate welded to the outer casing pipe to attach the pump head. Furnish and install a new pump head adapter plate and bolt to the new outer casing base plate.

j. Excavate and install four concrete pedestals to support new steel framing for well casing support system as shown on the plans. Fabricate and install new “X-shaped” pattern well casing support system that is welded to the 42” outer casing pipe and supported by the concrete caissons.

k. Re-install the Pump #8 motor using existing foundation plate onto the modified well casing as shown on the drawings.

l. Furnish and install the new discharge pipe including the new 12” tee and riser pipe the extends above the floor of the well building and terminate with new 12” valve.

m. Construct the concrete foundation for the new well building as shown on the drawings.

n. Construct the new well building for Pump #8 on the concrete foundation including metal siding, roof panels, doors, hardware, and louvers.

o. Install the new discharge piping from the pump to the 12” Riser pipe in the well building including pipe supports, valves, check

valve, and air release valves, miscellaneous piping and accessories.

p. Close the 30” main valves to isolate Wells #8 - #10 at the 36” raw water main to connect the new 12” discharge piing from the new well building to the existing 12” discharge pipe for each well.

q. Connect the new 12” blowoff piping from the cross fitting on the well pump discharge header to the existing drainpipe after the drainpipe has be cleaned and inspected.

r. Complete installation of electrical power, lights, instrumentation, and controls in new well building. Make temporary power connection from existing 4,160-volt service to new transformer in well building is the new 5 KV buried service is not operational.

s. Complete all HVAC and plumbing mechanical work as show on drawings.

t. Cut existing 12” discharge pipe and make connection to new 12” discharge from well building. Complete final grading and construct new concrete pad at well pump, gravel drives, and fencing. Complete fine grading and seeding of disturbed areas.

u. Once the well casing modifications are complete and the well pump, new piping, valves, meters, and controls are installed and operational, the Contractor shall relocate and reinstall the existing service mast, transformer, motor starter, and SCADA panel pole fed from existing overhead electrical service work until the new 5 KV service is fully operational. At this time the existing overhead service and temporary relocated panels can be removed.

4. Well #10

a. The existing Well #10 has an existing casing support X-bracing system already installed. Remove the existing bracing and make modifications to well casing as shown on the plans.

b. The four existing concrete caissons shall be extended above the proposed grade at Well #10 to the elevations shown on the plans.

c. Re-install the existing X-bracing system as shown on the plans

d. Repeat steps “a through u” described above for Well #8.

5. New Raw Water Transmission Main

a. Extend the existing 36” raw water transmission main from Well #1 to Well #6 but do not tie in until Wells #1-#6 are operational. There are two 36” valves that shall be installed on the crossover connections near Well #6 and the West Aerator. Dig exploratory potholes locate existing piping and valves and identify type of fittings on existing valves.

b. Crossover near Well #6: Schedule WTP outage work on existing 30” PCCP raw water to cut crossover pipe and install the 30”

valves on existing raw water main and crossover. Remove one pipe length of the existing 30” PCCP pipe and install new 30” valve on the crossover pipe and restrain valve. Remove the 30” valve on the east side of the existing raw water main and install new makeup piping. Relocate the new 30” isolation valve for Wells #1 -#6 before the 12” connection from Well #7 and reconnect from well #7. Wells #1 through #7 can now be connected to the new 36” raw water main from Wells #1 through #6 to the existing 36” to stub just east of crossover.

c. Remove the 36” x 30” tee on the crossover, 36” stub pipe to west, 30” crossover pipe, Wells #8-#10 30” isolation valve, and the existing 36” valve on main just east of crossover on new main to aerator. Install new 30” valves on crossover, 30” isolation valve for Wells #8-10, and the 36” stub to east. This allows from Wells #1 - #6, and #7-#10 to be discharged through the existing main to both the East and West Aerators.

d. Crossover near West Aerator: Schedule outage to install new 30” valve in crossover pipe and replace existing 36” isolation valves on both existing and new mains near West Aerator. Remove a section of pipe and install a new 30” valve in the crossover. Remove the 30” valve and install a pipe makeup in place of the existing 30” valve on new raw water main just west of crossover. The new crossover valve can be used to facilitate directing flows to either East or West Aerator when needed to shut down an aerator for renovations

e. Install the new flow control valves, valves, piping, and mag meters in existing valve and meter vaults as shown on the drawings that feed the West Aerators during the outage to install the new valves at the crossover near the West Aerator. The valve and meter will be replaced in the East Aerator when it is taken out of service for repairs.

f. New Raw Water Transmission Main serving Wells #1 - #6: Furnish and install new raw water transmission main complete to serve Wells #1 to #6 by open cut; tested, disinfected, and ready for service.

g. Furnish and install DIP fittings, joint restraints, and accessories in accordance with the drawings and specifications.

h. Furnish and install service connections in accordance with drawings and specifications.

i. Furnish and place all trench granular backfill material to backfill the trench in accordance with drawings and specifications.

j. Perform leakage test and successfully disinfect water main before placing new main in service.

k. Excess excavation shall be stored on-site at lagoon area or as directed by Owner. Final stockpile areas shall be graded and seeded.

6. Existing Raw Water Transmission Main Cleaning

   a. The Contractor shall submit a work plan for cleaning the existing raw water transmission mains, including the main serving Wells #1 through #6, Well #7, Wells #8 through #10, and the 30” and the existing 36” raw transmission mains from the wellfield up to the West Aerator. The plan shall identify wells being taken out of service, location for removal of sections of pipe to facilitate cleaning, cleaning methods, inspection, disposal of sediment removed from pipe, pipe replacement and/or repair details, and location and installation of inspection manways.

   b. The cleaning of the section of pipe from Well #3 through #6 shall require the new raw water transmission main serving Wells #1 to #6 to be operational before cleaning can proceed.

   c. Cleaning the raw water main from Wells #10 to the crossover at the main will require Wells #8 through #10 to be out of service during the cleaning operation. This will require well #1 through #7 to be fully operational to provide 10 MGD treatment capacity at the plant.

   d. Once the new 30” valve has been installed in the crossover piping near Well #6, the existing 30” raw water main can be taken out of service for cleaning. Piping shall be removed for cleaning and replaced as shown on plans. Flow to the plant shall limited to using only the full capacity of West Aerator. Work on the East Aerator should be scheduled to be completed when the cleaning of the 30” raw water main is ongoing.

   e. Cleaning and inspections of the 36” raw water transmission main will require the 30” crossover and 30” and 36” isolation valves at the West Aerator to be operational. Flow from the 30” main will be split between the East and one-half of the West Aerator. One half of the West Aerator may be taken out of service for construction new modifications. When cleaning and inspection is complete, the piping will be repaired, and new cleanouts installed.

   f. Once all the cleaning is complete, each section of pipe that was removed will installed with the necessary valves, cleanouts, air blowoff valves, and vaults installed at the locations shown on the drawings.

   g. Furnish and install DIP fittings, joint restraints, and accessories in accordance with the drawings and specifications.

      Furnish and install service connections in accordance with drawings and specifications.

   h. Furnish and place all trench granular backfill material to backfill the trench in accordance with drawings and specifications.

   i. Perform leakage test and successfully disinfect water main before placing new main in service.

C. Site Work for Wellfield

1. Remove existing fences prior to construction. Protect overhead power lines, power poles, and equipment during construction. Remove all construction debris, tools, trailers, workboxes, and equipment before completing site work.

2. Schedule work in accordance with Work Plan. Excess excavation shall be stored on site, used as fill for pump pads at Wells #8 through #10, or stored onsite adjacent to the lagoons or at locations as directed by the Owner.

3. Prepare site to rough grade, including establishing subgrade elevations, finish grades for paving and drainage at each well site.

4. Furnish and install sewers, water mains, drains, manholes, vaults, and appurtenance to the grades shown on the plans.

5. Provide concrete pads, sidewalks and equipment supports at each will at the locations shown on the drawing.

6. Final grade, install topsoil, and seed grassy areas at the locations shown on the plans and in accordance with the specification. Maintain sprinkling and erosion control measures until first mowing after grass covers seeded areas.

7. Furnish and install chain link fences and gates at the location shown on the plans.

8. The Wellfield service road begins at the edge of the paved parking area and extends down the fill past the Backwash Lagoons and then turns and heads west, crossing State Route 212, (Dolphin Road) and ends at Well #1. The existing gravel road has ruts and sink holes that shall be repaired, and will be regraded, and 3” of stone aggregate applied to resurface the roadway. Regrade the existing gravel drive in the wellfield from the main access gate at the WTP parking lot, past the entrance to the lagoon and into the north-south and east-west roadways that provide access to Wells #1 through #7. And Wells #8 through #10 as shown on the plans. and provide new granular backfill. Proof-roll the road surface as described in the specifications and repair any soft areas with granular backfill that is properly compacted before installing new 3” gravel roadway surface. Maintain dust control on roadway in the well field during construction.

9. Road crossings that are due to installation of the new discharge water mains from Wells #1 through #6 will be excavation and backfill up to grade as part of the scope of work to install the new water main.

10. Any concrete demolition, excavation, and backfill necessary to prepare the lower the pump casing pipes, relocated pump discharge piping, construct the well building, paving, walks, and gravel drives and parking areas at each well are not included in the scope of work for wellfield service road improvements, but are included in the scope of work to construct the proposed Well #1 through #10 improvements.

11. Parking areas and drives for each of the ten well sites from the edge of the service road to the well will be part of the scope of work for the modifications to each of the wells.

12. Construction of the new raw water transmission main will include the road crossing using a jacked and bored casing pipe jacked under the main road and is included in the scope of work to install the new raw water transmission main.

13. The installation of the electrical conduits will be through a bored and jack casing pipe to carry the PVC ductbank as shown on the plans and is included in the scope of work for that item.

14. Any site excavation, pipe removal, pipe replacement, pipe cleaning, sediment removal/hauling/disposal, concrete trust blocking, backfill, final grading and seeding are included in the scope of work for the cleaning and modifications to the existing raw water main, and not included in the scope of work for site work in the wellfield.

D. Sugar Creek Water Treatment Plant work. All tasks listed below are for the convenience of the Contractor(s) and shall include all necessary general, site, electrical, plumbing, and HVAC work to the point of final acceptance by the Owner.

1. West Aerator Building

a. The existing West Aerator has a single piping gallery that houses valves to feed the aerators and a valve to bypass the aerator completely and send flows to the filters. To maintain plant treatment operations, the Contractor shall keep one-half of the aerator in service and maintain the ability to treat flows up to 5 MGD during removal of the second half.

1. Remove and dispose offsite existing fascia, remove existing built-up roofing, and precast concrete planks and install new concrete planks, insulation, and roofing.

2. Install new roof drains, flashing, fascia, and new roof hatch as shown plans.

3. Remove, acid clean, and reinstall existing perimeter fence surrounding the second floor as shown on the plans.

4. Remove existing piping and valves as shown on the plans.

5. Remove, acid-clean, sand blast, and re-install existing aluminum tray support frames as shown on the plans.

6. Saw cut existing curb and install new dowels and rebar to anchor base plates of reconditioned tray frame columns.

7. Furnish and install new support angles to support new aluminum trays with bolted connections for attachment to existing tray support frames. Supports shall be reused and reinstalled with intermediate aluminum members and trays.

8. Furnish and install new aluminum aerator trays with perforated aluminum plates for the four levels of trays in each unit as shown on plans.

9. Install new raw water influent valves in the clearwell with new extension stems and floorstands.

10. Core drill openings for new floor drains and install drainage piping to connect to backwash water sewer system. Provide concrete topping to drain walkways surrounding tray support curbs as shown on the drawings.

11. Drain clearwell, remove and dispose of sediment, pressure-jet clean walls, floor, and ceiling. Inspect for cracks and spalled concrete. Notify Owner if defects are found and use allowances to make concrete repairs if authorized by Owner.

12. Replace valves and piping as shown on plans.

13. Cleaning and seal existing exterior and interior second floor masonry walls.

14. Clean aluminum handrails, and repair damaged pipe railing as noted on plans.

15. Install new insulated window panels in Aerator Building,

16. Install aluminum ladder, steel framing for new roof hatch, and aluminum roof hatch.

17. Coordinate work with other contractors for Plumbing, HVAC, Electrical, Instrumentation and Controls. When work on first half of the West Aerator is complete, repeat Steps 1 through 16 as described above.

18. Coordinate work with scheduled outages to construct new work, cleaning, and modifications to existing raw water transmission mains from well field, meter, and valve replacements.

19. Contractor to schedule work to refurbished only one of the three units at a time and maintain two units of either the West Aerator or East Aerator in service while work on an Aerator unit is being completed. Schedule extended outages to make critical interconnects and replace and piping and valves, while maintaining flows of 10 MGD to the plant with one aerator and pre-chlorinating the aerator bypass flow if needed.

2. East Aerator Building

   a. The existing East Aerator can be taken out of service provided the existing full capacity of the existing West Aerator is available.

      1. If renovations are not complete, delay taking East Aerator out of service until full treatment capacity of West Aerator has been restored and is fully operational.

   b. The East Aerator piping and valves are located in the yard, and there is no separate pipe gallery. All yard valves associated with East Aerator are being replaced, including the by-pass valve that allows raw water to bypass the East Aerator completely and send flows to the filters. In order to maintain plant treatment operations, the Contractor shall keep the West Aerator in full service and maintain the ability to treat flows up to 10 MGD during renovation and repairs of the East Aerator.

   c. Coordinate work with other contractors for Plumbing, HVAC, Electrical, Instrumentation and Controls. When work on first half of the West Aerator is complete, repeat Steps 3 through 16 as described above for the West Aerator Building.

      1. The roof of the East Aerator will not be replaced. The work in Steps 1 and 2 called for on the West Aerator will not be required, but a new opening will be cut into roof and a roof hatch with new flashing will be installed. A new ladder and steel framing will be provided as shown on the Contract Drawings.

   d. Coordinate work with scheduled outages to construct new work, cleaning, and modifications to existing raw water transmission mains from well field, meter, and valve replacements.

   e. Contractor to schedule work to maintain refurbished half of West Aerator and East Aerator in service while second half of west Aerator is complete.

3. Filter Piping Gallery - Piping and Valve Replacements

   a. Filter #1 through #4 were installed as part of the original 1959 construction of the original plant, and Filters #5 and #6 were added in 1995 to expand the plant to its current configuration. The existing lower level of the pipe gallery is situated between Filters #3 and # 5 on the north side, and Filter #2 and #6 on the south side of the pipe gallery. Water that has been aerated supplied Filters #1 through #4 through a 30” pipe and turn up into the influent flume adjacent to Filter #4. A venturi meter and flow control valve will be removed and replace as shown on the plans.

   b. Flow from the East Aerator enters the Filter Gallery through a 36” pipe that connects to the main header to Filters #5 and #6, and ties into the flume box where it is combined with flow from the West Aerator. Four 36-ich transfer pipes are located between

the clearwells under the pipe gallery with floor doors provided to access the four transfer pipes.

c. Each of the six (6) filters is feed from a common influent/washwater flume that is used to maintain constant head on the six filters by modulated the effluent valves to maintain a variable flow through each filter while operating under varying headloss conditions.

d. Each filter is divided into two filter cells “A and B” that utilize the same influent and backwash gullet flume along the long wall between each filter cell. 30” of anthracite media and 12” of gravel are supported on a clay tile underdrain system. Each filter cell will be refurbished by removing all the media, removing section s of underdrain to pressure-jet clean the underdrains, reaming drain holes to remove scale build-up in the underdrains, and then re-installing new underdrain blocks and new media in each filter. A new air scour backwash system will be installed to replace the existing two (2) surface sweep mechanisms and piping in each filter cell. Both filter cells must be removed from service when removing and replacing influent, effluent, backwash, and drain valves for the filter.

e. Influent flow from the West Aerator enters the pipe gallery from the south and flows into a junction chamber. Flow from the East Aerator is split to serve filter #5 and #6 and/or discharges into the flume that receives flow from the West Aerator.

f. Both 36” influent butterfly valves located on the first-floor entry and exit from the influent flume will be replaced with new 36” valve and operator and floorstands.

g. The 20” washwater from the Makeup Reservoir enters the pipe gallery from the south. The piping will be modified and new valves and a 20” magnetic flow meter installed. The Makeup Reservoir will continue to be used for backwashing filters until the new backwash pump is installed and operational, at which time it will revert to being a secondary backwash system.

h. A new 6” drain line will be installed on the washwater main to allow the Makeup Reservoir to be drained to the Backwash Chamber next to the first-floor flume so that the reservoir can be drained in the future.

i. The existing 36” influent pipe turns up and discharges into the Influent Flume. An existing 20” connection that was blind flanged will be used to connect to a new 24” bypass pipe that will be run through the main pipe gallery and discharge into the influent flume between Filters #1, #2, and #4. The existing wall of the influent flume will be cut to install a wall casting. The top slab of the influent flume will be cut to install two Stop logs in the floor of the main floor Filter Gallery. The tile floor will be cut and repaired, and a new aluminum coverplate installed flush with the tile floor. Two 24” valves will be installed at both ends of the bypass pipe.

j. The existing 3” surface wash water header that runs along the ceiling on both sides of the pipe gallery will be converted to NPW header for the pipe gallery. The valves and surface wash fittings will be removed up to the wall of each filter.

k. The Filter-to-Waste (F-T-W) piping and valves on each filter cell will be removed, and the new F-T-W pipe drains to the backwash header will be removed and a new F-T-W Pump and piping system will be provided as described below.

l. Removal and replacement of filter control valves for the six influent/effluent flumes and the effluent, air scour, and backwash water for each of 12 filter cells will need to be coordinated with the plant. Since the valves cannot be replaced without taking out all four Filter l#1-#4 or #5 and #6.

1. Six (6) 24” raw water influent valves feed the center flume between the two filter cells. Each of six filter will be removed and replaced with new valves and operators.

2. Six (6) 24” washwater effluent valves that drain the center filter flume for each of six filter will be removed and replaced with new valves and operators.

3. Twelve (12) 3” surface washwater valves will be removed and a blind flange installed on the wall casting.

4. Twelve (12) 10” effluent valves control the flow of filtered water that maintain a constant head on the filter while in filtering, will be removed and replace with new valves and motor operators. The 12 existing motor operators are 208 Volt, 3 Phase and will removed and be turned over to the City. The existing piping will be removed, and new piping and fittings installed in the effluent pipe that direct filtered water to the clearwells.

5. Twelve (12) existing 10” flow tubes will be removed and a new 10” magnetic flow meter will be installed,

6. Twelve (12) existing motor operated Filter-To-Waste valves will be removed, and a new valve and motor operator will be installed.

7. Twelve (12) Filter Head Loss strainer assemblies will be removed and replaced, and new piping and a new differential pressure transmitter will be installed.

m. Two (2) new 8” stainless steel air headers for the air scour system will be installed along each side of the filter gallery below the ceiling and extend from the Air Sour Blowers in the Mechanical Room to the east end of the pipe gallery at filter #5 and #6.

1. Twelve (12) new 4” butterfly valves with motor operators shall be used to supply air to the filter scour system.

n. A new dehumidification system will be provided for the filter pipe gallery. Two fiberglass ducts shall be provided by the HVAC contractor and run through the filter piping gallery. The Contractor will coordinate the ductwork installation with the proposed piping improvement planned for the filter pipe gallery.

o. Two (2) existing sump pumps in the filter pipe gallery will be removed and replaced.

p. Piping in the filter piping gallery shall be cleaned, painted, and wrapped with new piping insulation wrapping at the locations shown on the plans.

q. The existing steel catwalk and handrail shall be cleaned and painted.

r. Contractor shall coordinate outages with other outages for the well field and aerator improvements to minimize downtime.

4. Filter-To-Waste (F-T-W) Pump and Piping

a. In Filter Room for 5A, cut in a new opening in the concrete floor and install a new aluminum floor door to provide access for removal of the F-T-W pump.

b. Furnish and install a new constant speed F-T-W pump as shown on the drawings. The pump flow shall be metered by a magnetic flow meter and modulated using a flow control valve. Provide interconnecting piping, valves, and accessories to transfer water immediately following backwashing both filter cells to the Influent Overflow Chamber located by Filter Room #4 that discharges to the 24” Backwash Effluent Pipe that flows to the Backwash Lagoons for treatment.

c. Remove the existing F-T-W piping and valves, and install the new piping as shown on the plans. Twelve new Filter-To-Waste valves and motor operator will be installed.

d. Install new 6” F-T-W suction header that drains the filters to “ripen” the filter after each backwash cycle is complete and provide a new piping header to interconnect the 12 filter cells to a new F-T-W pump installed in the pipe gallery between filter #3 and #5. An auxiliary backup to the F-T-W Pump will be provided in the Filter Pipe Gallery off the F-T-W header at Filter #6 and equipped with a motor operated valve. Both the F-T-W pump discharge and the auxiliary backup shall be provided with 18” air gap as shown on the plans.

e. Flow from the pump shall be regulated by a new 6” flow control diaphragm valve and metered by a 6” magnetic flow meter before being discharged into the backwash flume that drains to the Filter Backwash Lagoons. The pump discharge is equipped with isolation valves and check valve.

f. Filter ripening shall be implemented using the SCADA system to control time allotted to flush the filter, and the totalized flow and flow rate after each backwash of a filter cell is complete.

5. Filter Renovation and Air Scour System

   a. The Contractor will provide a work plan to the Owner on the method and schedule for renovating the filters including filter media removal, disposal, filter underdrain removal/cleaning, filter box cleaning/inspection/repairs, new filter underdrain installation, air scour header installation, filter media replacement, media cleansing/backwashing, upgrading filter controls.

   b. Filters can be rehabilitated before valves in filter gallery are removed and replaced. Plant production shall remain at 10.7 MGD at Average Daily Flow (ADF) during filter rehab with five (5) remaining filters in reservice.

   c. Remove existing handrail to provide access to filter cell.

   d. Remove existing surface sweep assemblies and piping headers and drops in each filter cell.

   e. Remove media using vacuum method to remove anthracite media and gravel. Provide means for disposal offsite. At an approved landfill facility.

   f. Clean interior walls and launders within each filter box with high pressure jet cleaning system. Owner/Engineer shall inspect walls to determine if cracks or spalled concrete requires repairs using monies from allowance to seal leaks and restore concrete.

   g. Remove one row of filter underdrain block spanning the top of effluent collection trough that drains filter blocks. Coordinate all work with manufacturer of new filter underdrain blocks.

   h. Use high pressure jet cleaning system to clean the interior walls of each chamber in each filter blocks and flush and sediment back into the trough. The filter cell effluent valve shall be closed. Any flow shall be pumped into the center washwater flume and allowed to flow to the backwash lagoon. Coordinate this step with City to control diversion to specific lagoon of their choice.

   i. Each filter block underdrain tile consists of orifices (holes) cast in clay block, including orifices in interior of block. Clean scale buildup from orifice holes of existing clay block filter underdrain with wire-tool reamer. Wash down the filter floor to flush solids from filter cells. Owner/Engineer to inspect block to confirm holes are clean before proceeding with next step.

   j. Install new filter underdrain block per manufacturer' s recommendations. Install new anchors epoxy grouted into concrete floor and install manufacturer's recommended cement grout mixture between blocks to lock blocks into place. After prescribed time for curing per grout manufacturers' recommendation, proceed with next step.

   k. Use proper equipment per manufacturers' recommendations to install filter gravel and anthracite media to the proper depths, Measure and confirm media thickness after rinsing media per

sequence outlined in the specifications. All backwash water shall be routed to the existing backwash lagoons.

6. Air Scour System

   a. Remove acid- proof clay tile. Relocate electrical panels and reroute plumbing as needed to maintain sanitary and potable water services to building during construction.

   b. Brace and install columns and structural supports to carry weight of second floor currently supported by load-bearing masonry wall of the existing walls Battery Room to where new Air Scour Blowers will be installed.

   c. Install concrete equipment pads for blowers.

   d. Cut openings in roof of Mechanical Room, and flash new air intake vents. Install filters on each air intake pipe.

   e. Install piping, valves, expansion joints, coupling, pressure relief valves, gauges, and controls for each blower as shown in piping schematic shown on the drawings.

   f. Furnish and install 8” diameter Schedule 10 stainless steel air headers on each side of piping gallery with 4” motor operated butterfly valves to control air supplied to air scour piping manifold.

   g. Furnish and install four (4) air drop assemblies with differs and lower to sit atop gravel bed.

   h. Re-program SCADA system to utilize a combinations air and water backwash sequence, including provisions for opening and closing influent, effluent, drain valves, air scour control valves for each filter cell.

   i. Install new ATI or equal backwash water turbidity and bed expansion monitors in each filter cell and provide controllers that input turbidity and bed expansion versus time. Provide adjustable controls for starting air scour system on low air flow, and increase using VFD to provide maximum allowable air supply during backwash sequence. Stop blowers after preset time and start backwash pump and backwash and sequence for each cell. When both cells are backwashed, open Filter-to-Waste motor operated valve and F-T-W Pumps to operate for prescribed during selected in SCADA. Record F-T-W- flow rate and volume in SCADA. After filter is ripened, re-direct filter effluent to clearwell and close F-T-W valve.

7. Backwash Pump and Piping

   a. Remove existing plant water and Makeup Reservoir supply pumps in high service pump room.

   b. Cut concrete floor in High Service Pump Room install new Backwash Vertical Turbine Pump that draws backwash water from the High Service Clearwell No. 2 and is programmed in SCADA to be the primary method used to backwash a dirty

filter. SCADA will use a run time interval between backwashes, or a high headloss occurrence to alarm and notify the operator that a filter requires backwashing.

c. On the Backwash Pump discharge, install a new 20" backwash header will be equipped with check valve, magnetic flowmeter and modulating butterfly valve to control backwash rates supplied during each step of the backwash sequence. A 20" butterfly valve shall be provided at the end of the new backwash supply header where is connects to the west end of the existing backwash header in the pipe gallery. Each filter cell will be provided with a new motor backwash supply valve on the existing header. All piping will be painted and insulated to minimize corrosion and condensation in the pipe tunnel.

d. The SCADA system will be modified to select Primary Backwash System using new Backwash Pump, or the Secondary System using the existing Makeup Reservoir. A filter backwash sequence shall be provided that allows the operator to change backwash rates and durations from a SCADA display screen.

8. Cleaning and Inspection of Backwash Water Storage Reservoir

a. The existing Makeup Reservoir will be drained, pressure washed, and sediment in the tank removed and taken to the sludge lagoons for on-site dewatering. A new manually operated drain valve with box shall be provided to drain the reservoir and backwash water fill/feed line to the Backwash Water Drain line that flows to the lagoons.

b. The existing pipe, fittings, and venturi meter and modulating butterfly valve will be removed, and a new 16" magnetic flowmeter and modulating butterfly flow control valve shall be installed. The Backwash Reservoir shall be maintained as a backup secondary system if the Primary Backwash Pump is out of service.

c. Filter control panels for the six filters will be modified to provide selector switches on the filter consoles and to select which backwash system will be used either locally or from SCADA.

d. Backwash water currently drains through a 24" drain to the Backwash Water Treatment lagoons for solids removal.

e. The new Dechlorination Facilities will be provided to remove residual chlorine in the settled lagoon effluent prior to discharge into the local receiving stream.

9. Clearwell Cleaning, Inspection, Baffles, Gates, and Valves

a. The existing clearwells store filter water form the six filters. Currently, there are three clearwells: North Clearwell #1, and South Clearwell #2 that a common center Clearwell #3 that is located under Filters #5 and #6. In 1995, flow from Filter #1 and #3 were redirected and combined with Filter #5 , then flowed through 36" diameter transfer pipes into the Center Bay to the existing chlorine contact tank before flowing into the High

Service PS Clearwells #1 and #2. Additional chlorine could be added to maintain the required chlorine residual in the Finished Water supply.

b. Under this Contractor, the Contactor will construct two (2) new 15’ high concrete divider walls in Clearwells #1 and #2 to form the two new North and South Chlorine Contracts. The center bay between Clearwells #1 and #2 will be carry the combined flow of all six filters.

c. New openings will be cut into the existing clearwell wall to all flow to be redirected through new openings that will be equipped with new sluice gates into the two new Chlorine Contact Tanks constructed at the ends of Clearwells #1 and #2.

d. New 30” diameter bypass pipes with isolation butterfly valves will be constructed at the west end of the existing Clearwells #1 and #2 so that the flow center bay can be taken out of service to be cleaned.

e. New floor access hatches will be installed to provide access to the Clearwell #1 and #2 and the two new Chlorine Contact Tanks. Chlorine will be added to the entry into each tank and used to maintain the required chlorine residual in the finished water.

f. The existing Chlorine Contact Tank will be designated as the new Fluoridation Mix Tank where fluoride will be added at the entry points from the two new Chlorine Contact Tanks.

g. Diver reports included in Appendices, shows small amounts ¼” to ½” of silt that has accumulated in the bottoms of all the clearwells. As each chamber it drained to the backwash lagoons. The walls, ceilings will be pressure cleaned and inspected by the Engineer. Residual bottom sediment will be removed and tank and take to the backwash lagoons for dewatering prior to disposal. The floor will then be pressure washed pressure-jet cleaned and inspected for cracks and spalled concrete. An allowance is provided to make any repairs deemed necessary by the Engineer and/or Owner,

h. New baffle walls will be installed in Clearwells #1 and #2, and the North and South Chlorine Contact Tanks as shown on the drawings. Columns will be erected to span from floor to ceiling to allow the corrosion-resist and metal or FRP panels to be slide in between the column supports.

i. The Contractor will remove two of the existing access chambers located on the exterior walls of the Clearwells #1 and #2 of the at the west end of the clearwells #1 and #2 of the original plant. A new opening will be cut into the exterior wall of the two clearwells and a new access chamber constructed to allow entry into the clearwells for cleaning and inspection. New FPR access ladders with safety gates will be provided as shown on the drawings.

j. New level transmitters will be provided to monitor and control levels in the tanks. New Chlorine Residual Analyzers will be provided in the Chlorine Contact Tanks and Finished Water header leaving the plant to control and maintain proper chlorine residuals.

10. High Service Pumps

a. The surge valves. Butterfly isolation valves, piping and couplings will be removed by the Contractor from each of the existing High Service Pumps #1 through #5.

b. HS Pump #1 pump head and motor stand have already been replaced and the motor has been refurbished. Remove, clean, refurbish and provide new bearings to High service Pumps #2 through #5. The Contractor shall retain the services of an approved Pump Service Company to remove the motor and pumps and provide all services to have remove the existing pump head and install new pump heads/motor stands on each pump.

c. Power to the large 4,160-volt motors on HS Pumps #3, #4 and #5 will be disconnected by the Electrical Contractor. An approved Pump Service Company will remove the motor and load it on a truck to be delivered to the Motor Rebuilder for cleaning, inspection, and refurbishing with new controls, and returned to the plant and reinstalled on the pump reassembled.

d. The Pump Service Company shall remove the existing pump heads and install a new Schedule 80 steel pump discharge head and motor stand for each pump and reinstall the pumps.

e. The existing 4KV motor on Pump No. 2 will be removed by the Pump Service Company and a new 480-volt motor shall be procured by the Electrical Contractor. The Pump Service Company will be responsible for reinstalling the pump and new motor. This motor will be powered by a new 480-volt Variable Frequency Drive provided in the power distribution equipment provided by the Electrical Contractor. The Electrical Contractor shall provide all conduit and wiring shown on the drawings to repower the motor and controls. Refer to the Scope of Bid document for additional details.

11. Plant Finish Water Metering Chamber

a. The existing piping, fittings, venturi mete, shutoff valve and pipe connectors installed in the Finished Water Metering Chamber located in front of the main plant on the 42” transmission main, will be removed, and replaced with a new fittings, magnetic flow meter. butterfly valve, and connectors.

b. New lighting in the vault will be provided. Signals from the mag flow meter will be tied into the SCADA system.

12. Fluoride Room Improvements

a. New door hardware will be installed on existing man doors, but the door frame and door will be reused.

b. A new masonry wall will be constructed to create an operator room. An aluminum mandoor with stair landing, steps, and handrail will be provided otthe lower level.

c. A new hydrofluoric acid day tanks with cover will be provided and the piping from the storage tanks reconnected. New suction lines from the day tank will connect to three fluoride feed pumps located in the new Operator Room of the Fluoride Building. New fluoride feed lines will be installed to feed fluoride into each effluent stream after the two (2) Chlorine Contact Tanks that flow into to the Fluoridation Mix Chamber Clearwell.

d. New water lines with reduced pressure backflow preventers will be provided and new potable water piping and valves provided to supply dilution water supply lines equipped with backflow preventers will be installed on each injection line that the diluted fluoride solution.

e. One indoor eyewash and safety shower station in the Fluoride Storage Room, and one outdoor eyewash and safety shower station will be provided at the truck filling station.

f. A new 6” drain line will be provided from the Containment Sump of the Fluoride Building to the existing Pump-Out Sump adjacent to the Fluoride truck fill station. A diverter valve will be used during filling to send spills from truck filling operations into the Pump-Out Sump. During normal operations storm water that drains from the fill station pad will be diverted to a new storm sewer that carries stormwater to the local receiving stream.

g. New heating and ventilation systems will be provided to improve ventilation of the rooms in case of gas leaks as required to meet safety standards. Existing Chlorine gas detectors are provided and wired to the SCADA system.

h. New structural supports will be installed to support the weight of the larger roof-mounted exhaust fans and makeup air units.

i. New electrical panels, lights, and controls will be provided in the Cylinder Storage and Chlorinator Room.

13. Chlorine Building Improvements

a. New door hardware will be installed on existing man doors, but the door frame and door will be reused.

b. The two (2) existing 500 LB/Day chlorinators will be removed and replaced with new units. New chlorine gas piping will be installed from the chorine cylinders weigh scales in the Storage Room to the Chlorinator Room. New chlorine solution lines will be provided from the Chlorinators to six new distributors, and the solution feed lines replaces as show on the drawing between the distributor and the discharge points for Filter Pre-

Chlorination, Chlorine Contact Tanks, Finished Water and Aerators.

c. New water lines with reduced pressure backflow preventers will be provided and new potable water piping and valves provided to supply dilution water to the Chlorinators. A new outdoor eyewash and safety shower will be provided at the rear exit door of the building.

d. New heating and ventilation systems will be provided to improve ventilation of the rooms in case of gas leaks as required to meet safety standards. Existing Chlorine gas detectors are provided and wired to the SCADA system.

e. New structural supports will be installed to support the weight of the larger roof-mounted exhaust fans and makeup air units.

f. New electrical panels, lights, and controls will be provided in the Cylinder Storage and Chlorinator Room.

g. The roof drains will be re-routed to new storm sewers in the area, so they no longer discharge to the Backwash Lagoons.

14. Maintenance Garage

a. The existing gutter and downspouts will be replaced

b. New door hardware will be installed on existing man doors, but the door frame and door will be reused. Two new aluminum overhead coiling doors will be installed to replace the existing sectional doors.

c. The abandoned radio tower next to the Maintenance Garage will be removed.

d. A new concrete Oil/Water Separator will be provided to serve floor drains in the building, and the discharge routed to the new sewer to the sanitary sewer. Runoff from the roof drains will be routed to new splash blocks that drain to the new storm sewer being constructed to separate stormwater from the backwash lagoons.

e. Paving in the area will be replaced after construction of new underground improvements are complete.

f. The heating and ventilation systems will be replaced.

g. New electrical panels, lighting, and controls will be provided/

15. Backwash Water Lagoons

a. Three concrete-lined Backwash Holding Tanks are provided to hold backwash water to allow sediment to settle out prior to being discharged into the local receiving stream.

b. The City uses two (2) lagoons to treat backwash water and will be maintained in operation throughout the construction period.

c. No modifications to the existing influent/effluent sewers, grading, concrete junction chambers, concrete basins, overflow

structures are planned or included in the scope of work under this contract.

d. The third lagoon can be used by the Contractor to store and dewater scale removed from cleaning operations from scale removal from the existing raw water mains, solids removed from clearwells, and media and silt residue from cleaning the filter underdrains.

e. The Contractor shall remove all sediment form the three backwash lagoons as needed during construction of the wellfield and plant improvements, and all three lagoons will have sludge solids removed and the concrete lined basins pressure washed, and all wastewater and dewatered solids or slurries will be hauled offsite to an approved landfill once all construction work is complete as part of the work of this contract.

16. Sitework – New Roadway, Paving, Storm Sewers, and Yard Piping

a. Remove existing fences prior to construction. Protect overhead power lines, power poles, and equipment during construction. Remove all construction debris, tools, trailers, workboxes, and equipment before completing site work.

b. Schedule work in accordance with Work Plan. Excess excavation shall be stored on site, used as fill for pump pads at Wells #8 through #10, or stored onsite adjacent to the lagoons or at locations as directed by the Owner.

c. Prepare site to rough grade, including establishing subgrade elevations, finish grades for paving and drainage at each well site.

d. Furnish and install sewers, water mains, drains, manholes, vaults, and appurtenance to the grades shown on the plans.

e. Provide concrete pads, sidewalks and equipment supports at each will at the locations shown on the drawing.

f. Final grade, install topsoil, and seed grassy areas at the locations shown on the plans and in accordance with the specification. Maintain sprinkling and erosion control measures until first mowing after grass covers seeded areas.

g. Furnish and install chain link fences and gates at the location shown on the plans.

17. Surge Relief at WTP to Makeup Reservoir

a. An existing 16” pipe that was used to fill the Makeup Reservoir was abandoned in the 1996 expansion. A new 16” valve will be installed on the tee at the 42” header, and the line cut to install a new surge relief valve in a precast concrete vault to be situated along the wall of the Filter Building.

b. New piping, fittings, and valves will be provided to route the pipe along the East side of the filter Building and to connect to

the existing 20” backwash supply line from the Makeup Water Reservoir using 16” tapping sleeve and valve.

c. Once the Makeup Reservoir becomes a secondary system to backwash the filters, the line will no longer be used, and will be valved off in the pipe gallery so that it can be used as an emergency surge relief in the event of a power failures or other emergency condition. Water be contained in the Makeup Water Reservoir for re-use or drained back to the lagoons for treatment.

18. New Aboveground Fuel Tank

a. The City has contracted Burgess & Niple to remove and dispose of the existing 2,500 steel fuel tank located to the west of the Generator Building will be removed in accordance with OEPA tank removal rules and regulations.

b. B&N will retain the services of a licensed tank removal company to take furnish all labor, materials, tools, and equipment for the excavation, removal of existing steel tank and buried fuel lines conduit, disposal of contaminated materials if found, backfilling and final grading of the site. B&N will be responsible for coordination of the tank removal subcontractor with the Contractor. B&N shall review and approve the tank removal and closure plan, including scheduling the work, observation of work, soils and groundwater sampling and testing, and submitting final closure plan to OEPA for approval.

c. Contractor shall furnish and install a new aboveground fuel tank at the locations shown on the plans, including excavation, concrete foundation, backfill, tank installation, fencing, pipe bollards and new buried fuel lines piping.

d. Electrical Contractor shall furnish and install all instrumentation and controls, including conduit and wiring for power and control.

19. First Floor - Lobby and Entrance and LULA Elevator

a. Hand wash and clean the existing wall mosaic tiles, structural glazed tile walls, and grout. Protect the existing wall mosaic after cleaning until building construction is complete.

b. Install drilled shafts to support concrete grade beams and foundation for the new LULA elevator shalt.

c. Construct new CMU walls and insulated wall treatment for the new elevator shaft, including structural beams to form new addition to lobby to provide 1st floor access to LULA elevator. and floor Install new lintel beams and wall

d. Install new steel roof deck at the top of the elevator shaft.

e. Remove existing window system for existing front lobby entrance, including existing structural beams and columns that are no longer required. Furnish and install new columns and beams required to support new window system and roof deck as shown on the plans. Field verify all dimension for new window

curtain wall system and coordinate size and location of new and existing structural components with curtain wall system supplier.

f. Furnish and install new walls exterior building insulation system, roof insulation, flashing, and single-ply roofing, nailers, and facia as shown on the plans.

g. Construct new wall partitions t locations shown on the drawings.

h. Provide new suspended ceiling in Rooms 200, 203, 202, and rear halls Rooms 206 and 211. Coordinate locations of HVAC registers and lighting with HVAC and electrical subcontractors.

i. Fill the existing terrazzo-lined fountain basins with light-weight concrete fill and install new terrazzo floor to match color and patter of existing floor.

j. Construct new CMU walls, door for the Elevator Machine Room 101 located in the Filter Pipe Gallery Annex, and stairs and railings as shown on Contract Documents. Furnish and install new LULA elevator in shaft, final elevator interior and door trim, hardware, and new hydraulic unit in elevator machine room. Coordinate ventilation and electrical work with elevator installation.

k. Remove and replace existing mandoor and frame to first floor Filter Pipe Gallery Annex including door hardware

20. First Floor – Filter Pipe Gallery Annex Room 101, Restroom 107, Mechanical Room / Battery Room 106, Maintenance, Electrical, Generator Rooms, High Service Pump Room

a. Filter Pipe Gallery Annex Room 101:

1. Cut concrete floors and provide three (3) new floor door openings into existing clearwells at locations shown on drawings. Coordinate with scheduled outages required to perform filter and clearwell renovation work.

2. Coordinate maintaining the supply of potable water to existing plant operations during removal of existing piping in Annex along west wall, including migrating plant water piping, service water, makeup reservoir fill line, and backwash water, and surface wash water piping and valves, and pressure regulator stations and backflow preventors.

3. Relocate chlorine solution and fluoride solution lines to two (2) new and one (1) existing Chlorine Contact Tanks.

b. Electrical Room 103

1. Coordinate sequence of construction for wellfield and work on the High Service Pump with the installation of 5 KV transformers, switchgear, MCCs, power panels and migration of existing equipment and controls to new electrical systems with the electrical contractor.

2. Remove and replace exterior doors, overhead sectional doors, and door to Generator Room 120 in accordance with door schedule on plans and the hardware specifications as shown on plans and as specified.

3. Furnish and install new structural support systems to be installed under the rooftop HVAC unit. Field verify locations and dimensions of columns and beams with HVAC submittal drawings prior to fabrication.

4. Install a new lintel beam and aluminum overhead coiling door 103D.

5. Cut new roof opening at location shown on the plans and install roof access hatch, aluminum ladder, and repair roofing and install flashing

c. Storage Room 104

1. Remove and replace existing windows, doors and hardware as shown on plans and as specified.

2. Furnish and install new structural support systems to be installed under the rooftop HVAC unit. Field verify locations and dimensions of columns and beams with HVAC submittal drawings prior to fabrication.

3. Cut new roof opening at location shown on the plans and install roof access hatch, aluminum ladder, and repair roofing and install flashing.

4. Coordinate locations of new electrical conduit with Electrical Contractor with roof openings, piping, and HVAC unit supports.

5. Remove and replace broken concrete floor slab using allowance for concrete repairs in areas designated by the Owner/Engineer.

d. Mechanical Room 106 / Battery Room 106:

1. Coordinate the temporary relocation of the existing battery charger and UPS equipment to a temporary weatherized enclosure along the south wall of the Mechanical Room. The Electrical Contractor shall extend conduit and wiring as needed to reconnect emergency power to operate the cone check valves at each of the 5 High Service Pumps.

2. Demolish the South and East walls of the Battery Room and remove the clay tile floor tile in the entire floor.

3. Coordinate support and/or relocation of existing process piping, plumbing, and electrical conduits with the demolition work.

4. Coordinate removal of HVAC unit, boiler, boiler chemical treatment equipment, and dehumidifier unit. Located in existing room.

5. Furnish and install new air scour blowers, piping valves, and controls at the locations shown on the drawings.

6. Cut new opening in floor for access into Clearwell No. 2 after electrical panels have been relocated.

7. Reroute chlorine solution piping and plant water piping that runs along the east wall of the Mechanical Room, to install new electrical panels at location shown on plans.

e. Janitor Closer Room 106 and Rest Room 107:

1. Construct temporary Rest Room 107 for use wile second floor Toilet and Locker Rooms are being remodeled. Construct new wall, and coordinate with Plumbing, HVAC, and electrical contractor to provide temporary fixtures and services. Complete final installation after second floor toilet facilities are complete and ready for use.

2. Complete work on Janitor Closet Room 106 and Rest Room 107 after new 2nd floor toilet facilities are operational.

f. Filter Operating Pipe Gallery Room 108

1. Pressure clean all concrete walls and floors in the pipe gallery.

2. Remove and replace the door at the bottom of the stairwell with a new aluminum door and hardware per Door Schedule and hardware specifications.

3. Pressure clean and paint the handrail, floor grating, and supports at elevation 968.75 that runs the length of the filter pipe gallery.

4. Modifications and new piping and valves are described under other sections, and work shall be performed during scheduled outages where required.

5. Coordinate the removal and rerouting of the existing roof drains that tie into the existing backwash drainpipe in the filter piping gallery. Roof drains shall be removed and reconnected to the new storm sewer by the Plumbing subcontractor.

g. Hallway 109

1. Coordinate removal of mop sink and installation of new water heaters with plumbing subcontractor.

2. Repaint existing doors and frames in hallway, and replace all hardware as shown on plans and hardware specifications.

3. Paint all surfaces as listed in Finish Schedule.

4. Coordinate installation of new ductwork and cutting new opening in HSPS South wall of HS Pump Room 102 with HVAC contractor.

5. Remove and replace broken/sunken concrete floor slab using allowance for concrete repairs in areas designated by the Owner/Engineer.

6. Coordinate installation of 5 KV electrical transformers and pullboxes with electrical contractor.

7. Clean structural glazed tile and grout per plans.

8. Paint all surfaces as listed in Finish Schedule

21. General Architectural

a. Clean all structural glazed tile and grout per plans.

b. Paint all surfaces as listed in Finish Schedule.

c. Clean existing floors, walls, and ceilings when demolition work is complete.

d. Aluminum doors and frames will remain where designated in the door schedule, but the door hardware will be removed and replace as noted on the door schedule. Interior steel doors will be painted, and new hardware provided. Where new aluminum, steel, or wood doors are listed in the door schedule, the existing doors and frames will be replaced, and new hardware installed as listed door schedule and the hardware specifications at the location shown on plans and as specified.

e. All windows will be replaced to match existing openings in accordance as shown on the architectural elevations or shown sections and details. Contractor shall verify all field dimensions of existing openings and coordinate with window manufacturer/installer.

22. Second Floor – Lobby Room 201, Control Room 202, Halls Room 206 and 211, Operator Break Room 203

a. Relocate SCADA system servers and workstation to temporary area Control Room 104 to be designated as Main Control Room before starting demolition work on second floor.

b. Cut in opening in north wall of control room from new LULA elevator to send floor and install elevator trim and hardware.

c. Remove windows, doors, wall panels, and ceiling as shown on the plans. Maintain east and west access to Second Floor Filter Gallery during construction using front and rear stairs to access second floor. Provide plastic curtains to contain dust from migration into filter cells that remain in use during construction.

d. Hand wash and clean the existing wall mosaic tiles, structural glazed tile walls, and grout. Protect the existing wall mosaic after cleaning until building construction is complete.

e. Install drilled shafts to support concrete grade beams and foundation for the new LULA elevator shalt.

f. Construct new CMU walls and insulated wall treatment for the new elevator shaft, including structural beams to form new addition to lobby to provide first floor access to LULA elevator. and floor Install new lintel beams and wall

g. Install new steel roof deck at the top of the elevator shaft.

h. Remove existing window system for existing front lobby entrance, including existing structural beams and columns that are no longer required. Furnish and install new columns and beams required to support new window system and roof deck as shown on the plans. Field verify all dimension for new window curtain wall system and coordinate size and location of new and existing structural components with curtain wall system supplier.

i. Furnish and install new walls exterior building insulation system, roof insulation, flashing, and single-ply roofing, nailers, and facia as shown on the plans.

j. Construct new wall partitions at locations shown on the drawings.

k. Provide new suspended ceiling in Rooms 200, 203, 202, and rear halls Rooms 206 and 211. Coordinate locations of HVAC registers and lighting with HVAC and electrical subcontractors.

l. Fill the existing terrazzo-lined fountain basins with light-weight concrete fill and install new terrazzo floor to match color and pattern of existing floor.

m. Provide new CMU wall and door to Elevator Machine Room 101A in Filter Gallery Annex. Furnish and install new LULA elevator in shaft, final elevator interior and door trim, hardware, and new hydraulic unit in elevator machine room. Coordinate ventilation and electrical work with elevator installation.

n. Remove and replace existing mandoor to first floor Filter.

o. Install structural support systems for HVAC equipment on roof.

p. Install new walls partitions, windows and doors in Control Room, Laboratory, and Operator Break Room on the second floor. Provide fire-rated wall panels and window systems for second floor partitions.

q. Remove existing concrete fill in Control Room, and provide new terrazzo floor in Control Room to match existing floor color and pattern.

r. Coordinate all structural and architectural work with electrical, HVAC, and plumbing subcontractors.

23. Second Floor - Laboratory

a. Remove windows, doors, wall panels, and ceiling as shown on the plans. Provide plastic curtains to contain dust to work area.

b. Remove base cabinet and install new corner cabinet and base and wall cabinets as shown on the plans.

c. Remove and reinstall wall cabinets at a lower elevation above the existing sink base cabinets.

d. Install structural support systems for HVAC equipment on roof.

e. Install new walls partitions, windows and doors in lab.

f. Patch existing terrazzo floor to match existing floor color and pattern.

g. Coordinate all structural and architectural work with electrical, HVAC, and plumbing subcontractors.

24. Second Floor – Restrooms and Locker Rooms – Rooms 209 and 209A

a. Coordinate all demolition and new structural and architectural work with electrical, HVAC, and plumbing subcontractors.

b. Patch or repair all areas after demolition is complete. All existing and new drywall, CMU walls, and door frames shall be painted in accordance with Finish Schedule per Section 09 90 00. Painting

c. Women's Locker Room 209

1. Demolish existing, toilet partitions, fixtures, doors, floor tile and ceiling systems as shown on plans. Coordinate work with M/E/P subcontractors.

2. Demolish existing wall into entrance and cut new opening through pipe chase into new Women's Locker Room 210 as shown on plans.

3. Furnish and install new ceramic floor, metal studs, gypsum board, close off existing door in Room 210 to hall, and install new suspended ceiling tile system.

4. Clean the existing structural glazed tile block, and chemically clean cement tile grout.

25. Second Floor – Filter Main Operating Gallery and Filter Rooms

a. The Contractor will remove the existing single pane glass that look into the filter rooms. New anodized aluminum frames with thermopane windows will be provided. The door windows currently are thermopane, and only door hardware will be replaced as list in door schedule.

b. The existing skylights in the old and new filter rooms are slightly different in size, but all will be removed. The steel bar screen on the existing filters will be removed. Ten (10) new skylights with dual plastic plexiglass will be provided. Safety cages will be provided with each skylight. Any corroded steel framing will be removed, and recoated. New curbs and flashing will be installed as needed to install the new skylights and repair the existing single ply roofing.

c. Remove and replace existing aluminum windows in exterior masonry wall with new units with aluminum frames and thermopane windows. Provide vented windows with screens as shown on the drawings.

d. Remove and replace existing insulated Kal-Wal windows with new units to match existing windows. Provide aluminum frames with insulated plastic Kal-Wal to match existing openings.

e. Cut existing precast concrete roof deck for new openings in roof. Furnish and install all structural steel framework frame opening, support roof loads, carry the weight of precast roof planks, and support HVAC equipment. Install beams at locations shown on drawing to carry loads to walls or foundations on first floor.

f. Provide new roof hatches, plumbing vents, and equipment curbs for ductwork, Cut and repair existing single ply membrane and insulation at new openings. Install any necessary insulation board to provide proper drainage around new units.

g. Provide architectural safety handrail systems with weighted bases to meet OSHA codes for areas where edge protection is needed to access and service equipment located along the edges of roofs.

h. Remove and replace existing glass block windows with new aluminum frames with insulated plastic Kal-Wal to match existing openings.

26. Water Treatment Plant – Building Exterior

a. Pressure jet clean the exterior of the masonry building and seal brick after new windows are installed.

b. Repair or replace any defective sealant, expansion joints, or exposed, corroded metal.

c. Sand blast the underside of the roof deck overhang to remove existing paint and expose concrete underside of precast roof planks.

d. Remove and reinstall existing stainless steel letters to be flush with masonry walls at the location shown on plans.

e. Install new plastic water drop logo insignia on front of new Elevator shaft as shown on plans.

f. Pressure wash concrete canopy at front of building. Install new roofing and flashing.

g. Install aluminum ladder at location shown on plans to access upper roof deck.

27. Site Work at Main Water Treatment Plant -

a. The Contractor shall furnish all labor, materials, tools, and equipment to construct site improvements for the water treatment plant. The proposed work may require short outages to make connections that shall be approved by the Owner in advance of the work, and shall be consolidated when possible other planned outages in the plant or wellfield to minimize downtime. The

scope of work for the proposed site improvements includes the following listed under this section.

b. Remove existing masonry wall and planter at the entrance to the plant at Dolphin Road. Construct new reinforced concrete footers and masonry walls as shown on plans. Provide new and install new flush mounted letters and water drop logo on wall. Provide power receptable using existing electrical feed. Install new solar power unit with photocell to power new LCD spotlight to illuminate sign.

c. Install silt fence to protect against soil erosion within work area. Regrade area along both sides of road to provide positive drainage away from road to existing drainage course or proposes swale. Install new perforated drain tile to collect groundwater and discharge into existing drainage course. Install new concrete headwall at storm drain at location shown on plans.

d. Remove existing gravel drive wearing surface and excavate to install new granular base course and asphalt pavement to extend from Dolphin Street to parking area of water plant. Regrade lawn areas adjacent to pavement to provide positive drainage away from edge of pavement to new drainage swale as shown on plans.

e. Construct new motor operated gate at end of drive and connect existing fentoce new gate.

f. Excavate for new roadway to extend from front entry gate around the the east side of the Filter Building to connect into the existing drive at the Fluoride Building behind the main plant. Remove existing fence and construct new drainage swale along east side of Filter Building.

g. Install new granular base and asphalt pavement for new drive around filter building. Install pipe bollards to protect building and stairs on east side of filter building.

h. Remove radio antennae mast at Maintenance Building.

i. Remove underground water storage tank in grassy area to the left of front lobby, and abandon existing lawn sprinkler piping that interferes with new construction.

j. Furnish and install new storm drain from Filter Building to connect to existing Junction Chamber at southeast corner of West Aerator building. Storm sewer will extend to intercept downspout on Filter Bldg., flow from pavement at Fluoride fill station, yard drains, and pavement area at to the west of Chlorine Building and Maintenance Garage. Provide manholes and frames with lids at locations shown on plans. Connect downspouts and area drains as shown on plans. Provide splashblocks were not connection is provided. Regrade new pavement and grassed areas to provide positive drainage for stormwater runoff.

k. Locate existing 16” DIP water fill line to Makeup Reservoir and provide excavation and backfill to install new 16” water blowoff line that connects to existing 16” Makeup Reservoir Backwash supply line at rear of plant. Furnish and install new precast concrete valve vault with isolation valves for automatic surge relief valve. Install new pressure transmitter on new 6” drain line

for makeup Reservoir, and connect to Backwash Effluent in pipe gallery.

l. Construct new 8” sanitary sewer between Mechanical Room and existing septic tank.

m. Cut existing pavement and excavate for installation of new 12” storm sewer to extend from two inlet basins at Chlorination Building to headwall in hillside west of septic tank field.

n. Install new valves on yard piping at the locations shown on the plans including influent and effluent lines of the East and West Aerators.

o. Install new magnetic flow meter and valve in existing concrete vault to west of the West Aerator Building.

p. Install new magnetic flow meter and valve in existing concrete vault to south of the East Aerator Building.

q. Connect floor drains of the East and West Aerators to the Backwash Effluent line to the Lagoons.

r. Excavate and remove existing 2,000-gallon buried steel fuel storage tank and buried fuel line. Provide approved tank remediation firm to provide oversight, coordination, testing, and closure report that meet OEPA guidelines. Backfill site when testing is complete and shown to be in full compliance with OEPA requirements.

s. Remove existing pavement in front parking area and place new granular base and wearing surface as locations shown on plans. Install new curb in circular grassy area in front of main lobby. Regrade areas adjacent to pavement properly drain and reseed.

t. Remove and reinstall fence deemed in good condition. Install new fence to replace damaged fence or provide additional fence and gates as shown on plans or needed.

u. Furnish and install new reinforced concrete base slab and footers for new 3,000-gallon concrete fuel storage tank with double wall containment system, controls, piping, pumps, and valves. Run underground piping to connect to existing fuel day tank in Generator Building. Provide power and control wiring for level controls and alarms and integrate signals with SCADA system. Provide pipe bollards and new fence to enclose above ground fuel tank.

v. Remove existing pavement on west side of High Service Pump Room and Generator Building. Provide fill to regrade area to slope drive up to the new overhead coiling door installed in the west wall of the High Service Pump Room. Excavate and regrade to provide new granular base and surface wearing coarse for new asphalt pavement connecting the front and rear parking areas of the plant.

w. Provide new 1-1/2”chlorine solution lines along the front and rear sides of the West Aerator Buidling use for pre-chlorination, including excavation, material, installation, and backfill, and testing.

x. Install new 2” NPW lines at the front and back of the West Aerator Building and reconnect to existing water lines. ,

including excavation, material, installation, and backfill, and testing.

y. Furnish and install new magnetic flow meter on 42" finished water header in valve vault located in front parking lot paved area.

28. Dechlorination Facility- A new building shall be constructed to hold four (4) 330-gallon totes and two chemical feed pumps for metering chemical into the main outfall sewer of the three lagoons upstream of the headwall at the stream where the samples are collected. Chemical tubing shall be used to carry the Sodium Bisulfite solution to the effluent Manhole No. 11 through a 3" carrier pipe and tubing to the point of application where it is injected into the effluent stream where the chlorine residual is reduced.

a. A new Dechlorination Building will be constructed under this contract as an early action time

b. Clear the site to brush, strip, and store topsoil. Remove the existing fence as shown on plans and install temporary fencing around construction area.

c. Excavate for the new foundations and construct reinforced concrete footers including formwork, rebars, wire ties, water stops, expansion joints, and construction joints as show on plans. Furnish and install water lines from curb stop into building (City to provide pipe tap and extend new water line to a curb stop), electrical conduit and process piping through wall sleeves of footer and stub up through floor slab. Install insulation board along footers and backfill excavation.

d. Compact subgrade to form floor slab. Install plastic moisture barrier and insulation board under floor slab. Construct reinforced concrete footers, floor slab, and curbs including rebar, control and expansion joints. Coat the floor in accordance with 09 90 00 – Painting with chemically resistant coating suitable for intended use.

e. Provide all labor, materials, equipment, and tools to erect the new 384 square foot insulated metal building including structural columns, purlins, girts, steel framing. Pre-finished metal siding and standing seam roof, ridge beam, vent, insulation batts, interior metal liner plates for walls and ceiling, insulated metal overhead door, mandoor, wall louvers and vent openings.

f. Install chemical pumps and piping as shown on plans. Excavate and install new 3" diameter carrier pipe from building to MH #11. Pull tubing through carrier pipe and install discharge piping in manhole. Connect tubing to rigid PVC piping and valves fed from two wall-mounted chemical pumps. Install and provide suction tubing from pumps to totes with sodium bisulfite chemical. The City will provide four chemical totes with 250 gallons of chemical in each tote delivered to the jobsite. Each tote is equipped with a 2" ball valve facing the front of the tank within the molded base of the tank for connection to chemical

suction line to pump. Test all piping for leaks and correct any defects.

g. Excavate for new drain manhole adjacent to building, and backfill excavation when manhole is installed. Furnish and install new precast concrete drain manhole including flat top cover with embedded aluminum single leaf floor door and manhole steps. Install watertight seals for drainpipe that passes through the wall. Coat the interior of the drain manhole and floor of building with chemically resistant epoxy coating suitable for intended use. Perform water leak test on the drain manhole and piping in accordance with the specifications and repair any defective or leaking joints.

h. The City will provide the pipe tap and 1" service up to terminate at a curb stop and box. The Contractor shall extend the water line into the building; and furnish and install cold and hot water lines, pipe insulation, valves, and accessories as shown on plans. Install eyewash including backflow preventer, hot water tank, eyewash, piping, valves, and accessories.

i. Furnish and install new electric unit heater and thermostat. Cut openings in walls of metal building to install louvers and exhaust fans and provide labor and materials to mount ventilation equipment.

j. Furnish and install new electrical wiring to feed new Dechlorination Building from a new circuit breaker installed in the existing power panel in the Aerator Building. Provide all excavation and backfill to install underground electrical cables and ductbank. Install electrical panels and transformers in Dechlorination Building. Furnish and install all conduit and wiring to install new chemical pumps, unit heater, exhaust fan, interior and exterior lighting at the locations shown on the plans. Provide electrical boxes, switches, devices, conduit, wiring, hangers and supports to install new lighting and receptacles at locations shown on plans.

k. Remove all construction debris, trailers, and equipment from the construction site. Restore the site to proposed grade elevations, and install concrete drive apron, sidewalk, and gravel drives. Install new fence as shown on plans. Fine grade, topsoil and seed all disturbed areas.

l. When work is completed, the Contractor shall remove all SWPPP materials and grade all disturbed areas of new work, fix or replace any damaged asphalt pavement, to establish proper elevations at the building, roadway, and surrounding areas that drain to the existing 30" storm sewer, electrical ductbanks, material laydown areas, construction trailer parking areas, and any areas disturbed during construction of the Dechlorination Building. After final grade is established, spread topsoil and seed all disturbed areas. Dispose off-site, all waste concrete and asphalt material removed from demolished roadways.

E. HVAC work. All tasks listed below are for the convenience of the Contractor(s) and shall include all necessary general, site, electrical, plumbing, and HVAC work to the point of final acceptance by the Owner.

1. Wellfield Mechanical Work.
2. Aerators Mechanical Work.
3. High Service Pump Room Mechanical Work.
4. Fluoride Room Mechanical Work.
5. Chlorine Building Mechanical Work.
6. Maintenance Garage Mechanical Work.
7. Second Floor Filter Galleries, Laboratory, Control Room, and Operator Area Mechanical Work.
8. First Floor Mechanical Work.
9. Dehumidification Unit and Ductwork for Piping Gallery.

F. Plumbing work. All tasks listed below are for the convenience of the Contractor and shall include all necessary general, site, electrical, plumbing, and HVAC work to the point of final acceptance by the Owner.

1. Aerators Plumbing Work.
2. Fluoride Room Plumbing Work.
3. Maintenance Garage Plumbing Work.
4. Above Ground Fuel Tank Plumbing Work.
5. Second Floor Restroom and Locker Rooms Plumbing Work.
6. First Floor Plumbing Work including a new Restroom.

G. Electrical and I&C work. All tasks listed below are for the convenience of the Contractor and shall include all necessary general, site, electrical, plumbing, and HVAC work to the point of final acceptance by the Owner.

1. Submit a detailed work plan and schedule and reviewed prior to start of construction.
2. Contractor shall perform work while maintaining operation of the wellfield pumps during construction. The suggested sequence for Phased Construction of Wellfield Improvements is below

    a. Temporary power to Wellfield Pumps #1 through #10 may be required until new 5 KV underground power distribution equipment is operational. Until then, wells shall be powered from existing overhead 5 KV line using existing transformers, motor control panel, and SCADA panel for pump controls.

    b. Phase 2 work during renovation of second floor of the plant will require relocation of SCADA Control Room to temporary room constructed on first floor. Network communications equipment, servers, workstations, and printers will be relocated prior to demolition of existing SCADA control room.

3. Electrical work includes electric power distribution, MCCs, VFDs, Panels, Local PLC panels, power, control, lighting, instrumentation, controls, SCADA hardware and software, CCTV security systems, telecommunication systems. In general, the following will need to be sequenced by the Contractor to keep the plant operational. Temporary power and relocation of the SCADA Control Room are required to be coordinated and paid for by the Contractor as part of the Contract.

   a. Electrical Service – 4160V Distribution System Upgrade.

   b. Electrical Service – 460V Distribution System Upgrade and Pump Motors.

   c. Electrical Services for Main Plant lighting, receptacle, conduit, and wiring.

   d. Electrical Services for HVAC.

   e. Electrical Services for new and existing equipment.

   f. Electrical Service – Wellfield Metering and Instrumentation Upgrades.

   g. Electrical Service – WTP Metering and Instrumentation Upgrades.

   h. SCADA System Hardware – Sugar Creek WTP.

   i. SCADA System Software – Sugar Creek WTP.

   j. SCADA System Upgrade – Wellfield.

   k. CCTV security systems.

   l. Electrical Services for Dechlorination Facility.

END OF SECTION

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SECTION 01 31 19.01

PROJECT MEETINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor and materials necessary to attend and participate in project meetings in accordance with the plans and specifications.

B. **Conferences and Meetings**. This section specifies administrative and procedural requirements for project meetings including but not limited to:

1. Preconstruction conference.

2. Progress meetings facilitated by the Engineer.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS (Not used)

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS (Not applicable)

PART 3 EXECUTION

3.1 PRECONSTRUCTION CONFERENCE

A. **Schedule**. The Engineer/Architect will schedule and conduct a preconstruction conference and organizational meeting at the project site or other convenient location after execution of the agreement and prior to commencement of construction activities. No work shall commence prior to the meeting.

B. **Attendees**. The Owner, Engineer/Architect and their consultants, the Contractor and their superintendents, major subcontractors, manufacturers, suppliers, and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work.

C. **Agenda**. Discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule.

2. Critical work sequencing.

3. Designation of responsible personnel.

4. Procedures for processing field decisions and Change Orders.

5. Procedures for processing Applications for Payment.

6. Distribution of Contract Documents.

7. Submittal of shop drawings, product data, and samples.
8. Preparation of record documents.
9. Use of the premises.
10. Office, work, and storage areas.
11. Equipment deliveries and priorities.
12. Site safety.
13. Security.
14. Housekeeping.
15. Working hours.
16. Others as appropriate.

D. **Minutes**. Within 7 days of the preconstruction conference, the Engineer/Architect will distribute minutes to all attendees.

3.2 PROGRESS MEETINGS

A. **Schedule**. The Engineer will conduct progress meetings at the project site every two weeks.

B. **Attendees**. In addition to representatives of the Owner, Engineer, and Contractor, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings by persons familiar with the project and authorized to conclude matters relating to progress.

C. **Agenda**. Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the project.

1. Contractor's Construction Schedule.
    a. Review progress since the last meeting.
    b. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead of or behind schedule.
    c. Determine how construction behind schedule will be expedited.
    d. Secure commitments from parties involved to do so.
    e. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the contract time.
2. Review the present and future needs of each entity present, including such items as:
    a. Interface requirements.
    b. Completion times.
    c. Preferred sequences.
    d. Delivery schedule.

e. Off-site fabrication problems.

f. Access issues.

g. Site utilization.

h. Temporary facilities and services.

i. Hours of work.

j. Hazards and risks.

k. Housekeeping.

l. Quality and work standards.

m. Change Orders.

n. Documentation of information for payment requests.

D. **Schedule Updating**. The General Construction Contractor shall revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized and submit the revised schedule within 3 days of each progress meeting for distribution with the minutes.

E. **Minutes**. Within 7 days of the progress meeting, the Engineer will distribute minutes on a SharePoint site.

END OF SECTION

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SECTION 01 32 16

CPM SCHEDULES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall perform the work necessary to provide the Critical Path Method (CPM) schedules for all work in accordance with the drawings and as specified herein.

B. **Requirements.** This section specifies administrative and procedural requirements for the CPM of scheduling and reporting progress of the work.

1. Refer to General Conditions and the Agreement for definitions and specific dates of Contract Time.

1.3 QUALITY ASSURANCE

A. **Consultant.** The Contractor shall retain a Consultant to provide CPM scheduling services, including planning, evaluating, and reporting.

1. The Consultant shall be a recognized specialist, expert in the CPM of scheduling and reporting, and acceptable to the Engineer/Architect.

2. The Consultant shall have computer facilities available with sufficient capacity to process detailed network diagrams within 48 hours of a request.

B. **In-House Option.** The requirement to retain a Consultant may be waived if the Contractor can demonstrate to the Engineer/Architect's satisfaction that:

1. The Contractor has the computer equipment required to produce CPM network diagrams.

2. The Contractor employs skilled personnel who are experienced in CPM scheduling and reporting techniques.

C. **Program.** Use a computer software program for network analysis that has been developed specifically to manage CPM construction schedules and is acceptable to the Engineer/Architect.

D. **Standards.** Comply with procedures contained in "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry," published by The Associated General Contractors of America.

1.4 SUBMITTALS

A. **Preliminary Network Diagram.** Within 15 calendar days after the date of the Notice to Proceed, submit a preliminary network diagram outlining activities for the first 90 days of construction. Include a skeleton diagram for the remainder of the work with the preliminary diagram.

1. Include each significant construction activity. Coordinate each activity in the network with other activities. Schedule each construction activity in proper sequence.

2. Indicate completion of the work in advance of the date established for Substantial Completion.

B. **Schedule of Values.** With the submittal of the preliminary network diagram, include a schedule of values and a preliminary monthly cash requirement prediction based on all indicated activities.

C. **Tabulation of Submittals.** With the submittal of the preliminary network diagram, include a tabulation by expired date of submittals required during the construction. List those required to maintain orderly progress of the work, and those required early because of long lead time for manufacture or fabrication. Contractor shall allow 2 weeks' time for Engineer/Architect's first review and 2 weeks' time for Engineer/Architect's second review.

D. **Distribution.** Distribute the preliminary network diagram to all parties that need to know about construction activities that are scheduled during the first 3 months, including the Engineer/Architect and Owner.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

1.8 DEFINITIONS

A. **Critical Path Method**. CPM is a construction scheduling technique using network analysis diagrams to plan and organize construction activities in an orderly manner along the critical path.

B. **Network.** A network diagram is a graphic representation showing the relationship of activities and events in the correct sequences required to complete the project within the Contract Time.

C. **Activity.** An activity is any single identifiable step in the project. It depends upon and cannot begin until completion of all preceding activities.

1. Critical activities are activities with no (zero) float time and are, therefore, operations that determine the critical path and control project completion.

D. **Event.** An event is the starting or ending point of an activity and occurs only when all preceding activities have been completed.

E. **Float Time**. The amount of time available for a given activity in excess of its estimated duration. It represents the amount of leeway available in scheduling an activity. All float time belongs to the Owner.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.

2. Total float is the amount of time an activity can be delayed without adversely affecting overall time for project completion.

PART 2 PRODUCTS

2.1 CPM SCHEDULE

A. **General.** Prepare a CPM schedule in accordance with Part 3 of this section. The CPM schedule shall include a complete listing of all abbreviations and symbols utilized within the CPM schedule.

PART 3 EXECUTION

3.1 CPM SCHEDULE

A. **General.** Prepare a CPM Construction Schedule using the network analysis diagram system known as the Critical Path Method (CPM) following procedures outlined in "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry," as published by The Associated General Contractors of America.

1. Follow the steps necessary to complete development of the network diagram in sufficient time so that the CPM schedule can be submitted and accepted for use no later than 60 calendar days after the date of the Notice to Proceed.

2. Conduct educational workshops to train and inform key project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.

3. Establish procedures for monitoring and updating the CPM schedule and for reporting progress; coordinate procedures with progress meeting and payment request dates. Use "one working day" as the unit of time.

B. **CPM Schedule Preparation.** Prepare a listing of all activities involved in the project; include every activity having a bearing on the time required to complete the work. Provide the best data available for generation of the network diagram and CPM schedule.

1. Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities.

2. Indicate estimated times for the following activities to be performed:

a. Preparation and processing of submittals.

b. Temporary construction services and facilities.

c. Purchase of materials.

d. Delivery.

e. Fabrication.

f. Installation.

g. Start-ups.

h. Operational demonstration.

i. Training.

j. Progress meetings.

k. Preconstruction conference.

C. **Processing.** Enter prepared data on the processing system. Process data to produce output data or a computer drawn time scaled network based on calendar days. Draw network by hand if the equipment is unable to do so. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the best possible CPM construction schedule within the limitations of Contract Time.

D. **Format.** Display the full network on a single sheet of stable transparency, or other reproducible media, of sufficient width to show data clearly for the entire construction period.

1. Mark the critical path. Locate the critical path near the center of the network; locate paths with the most float near the edges.
2. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. **Initial Issue.** Prepare the initial issue of the CPM Schedule network diagram from a listing of straight "early start total float" sort. Identify critical activities. Prepare tabulated reports to show the following:

1. Contractor or subcontractor and work or activity.
2. Principal events of that activity.
3. Early and late start dates.
4. Early and late finish dates.
5. Activity duration in working days.
6. Total float or slack.
7. Average size of work force.
8. Dollar value of activity (coordinated with Schedule of Values).
9. Value Summaries. Prepare two cumulative value listings, sorted by finish dates.
    a. In first listing, tabulate the following:
        1. Activity number.
        2. Early finish date.
        3. Dollar value.
        4. Cumulative dollar value.
    b. In the second listing, tabulate the following:
        1. Activity number.
        2. Late finish date.
        3. Dollar value.
        4. Cumulative value.
    c. In subsequent issues of both listings, substitute actual finish dates for activities completed as of date of listing.
    d. Prepare listing for ease of comparison with payment requests; coordinate timing with Progress Meetings.

e. In both value summary listings, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

f. Submit value summary printouts following each regularly scheduled progress meeting.

F. **Submittal and Distribution.** Submit the initial issue of the tabulations and network for acceptance. When authorized, distribute copies to the Engineer/Architect (three copies), Owner, principal subcontractors and suppliers or fabricators, and others identified by the Contractor with a need-to-know schedule responsibility.

1. Post copies in the project meeting rooms and temporary field office.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the work and are no longer involved in performance of construction activities.

3. Submit copies of each computer produced report (listing) in duplicate to Engineer/Architect.

G. **Schedule Updating.** Revise the schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each project meeting.

END OF SECTION

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SECTION 01 32 33

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to furnish the construction photographs in accordance with the plans and specifications.

1.3 QUALITY ASSURANCE

A. **Qualified Photographer**. Engage a commercial photographer to take photographs during construction. Photographer shall be a firm or an individual of established reputation who has been regularly engaged as a professional photographer for not less than 3 years.

B. **Associated Services.** Cooperate with the photographer's work. Provide reasonable auxiliary services as requested, including access and use of temporary facilities including temporary lighting.

1.4 SUBMITTALS.

A. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Monthly Photos

1. For the preconstruction photos and monthly photos, submit three (3) USB 3.0 Flash Drives containing the photographs taken for that month. Electronic photographs files shall be in JPEG (.jpg) format.

2. At the completion of the project, submit all photography taken of the project on three (3) separate USB 3.0 Flash Drives of sufficient size to contain the complete electronic submittal.

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 IDENTIFICATION.

A. Label each photograph on the front in the bottom margin with project name and date the photograph was taken with the following information.

1. Name of the project.

2. Name and address of the photographer.

3. Name of the Engineer/Architect.

4. Name of the Contractor.

5. Date the photograph was taken.

6. Description of vantage point, in terms of location, direction (by compass point), and elevation or story of construction.

PART 3 EXECUTION

3.1 EXECUTION

A. Preconstruction Photos: A minimum of two-hundred (200) preconstruction photos shall be taken of the jobsite prior to construction activities.

B. Monthly Progress Photos: A minimum of fifty (50) photos shall be taken each month for the duration of the project. Photos shall be taken to document the construction progress for the project duration and identify the location of the work as specified herein.

3.2 ADDITIONAL PHOTOGRAPHS.

A. From time to time the Engineer/Architect may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum or an Allowance.

1. **The Engineer/Architect** will give the photographer 3 days' notice, where feasible.

2. **In emergency situations**, the photographer shall take additional photographs within 24 hours of the Engineer/Architect's request.

3. **Circumstances that could require** additional photographs include, but are not limited to:

a. Substantial completion of a major phase or component of work.

b. Owner's request for special publicity photographs.

c. Special events planned at project site.

d. Immediate follow-up when on-site events result in construction damage or losses.

e. Photographs to be taken at fabrication locations away from project site; these are not subject to unit prices or unit cost allowances.

f. Extra record photographs at time of final acceptance

END OF SECTION

SECTION 01 32 34

PRECONSTRUCTION AUDIOVISUAL RECORDING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to furnish the audiovisual recording of the entire project site on an external drive.

1.3 QUALITY ASSURANCE

A. In addition to the requirements listed herein, the Contractor shall also comply to the requirements for preconstruction video as detailed in Supplemental Specification 01-00. for additional requirements for the Preconstruction Video.

1.4 SUBMITTALS

A. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Sample Video

1. At the start of the recording, submit a video of a portion of this project on an external drive. No taping shall occur before the sample video is approved.

C. Submittal Package No. 2 – Video Files and Logs

1. Video Log. Provide a log that accurately catalogs the contents of each video in an acceptable manner. Information in the video logs shall include the following:

a. Street name, easement, or address.

b. Sheet number or numbers relative to the line entry of a particular area of coverage.

c. Real-time code indexing for each segment of the project. Real-time code indexing will indicate hours, minutes, and seconds to cross reference with playback equipment to locate specific points of interest on the project.

d. Direction of travel for each specific segment.

e. Viewing side for each specific segment.

f. Starting point for each specific segment.

g. Ending point for each specific segment.

h. Project information (project title, Owner, date, location).

2. Video Files. Label all video files and external drives with project information in an acceptable manner. Cross reference the information on

the labels with the video logs. Information on labels shall include the following:

a. Project title.

b. Location of project.

c. Month and year of coverage.

d. External drives must be marked as sets (Engineer set, Owner set, Contractor set).

e. Quick reference list of the contents of the video(s).

1.5 JOB CONDITIONS

A. **Recording**. Record each area and submit video before mobilization begins. All recording shall be witnessed unless waived in writing.

B. **Visual Inspection**. Prior to recording, investigate all areas visually with notation made of features not readily visible by recording methods. This would include, but not be limited to, culverts (size, type, condition) and manholes that may be partially buried. Record all measurements made during the inspection.

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 EQUIPMENT

A. **Camera/Camcorder**. The camera/camcorder shall have the following features:

1. Color.

2. High-resolution, digital recording.

3. 1/4-inch, 1/3-inch, or 1/2-inch charged coupled device imaging systems.

4. Optical Stabilization. No electronic stabilization.

5. 20X minimum optical magnification.

6. NTSC 525 lines resolution/60 fields/30 frames per second.

7. Minimum illumination capabilities of at least 3 lux.

B. **Wheeled Vehicles**. Clearly mark vehicles used for recording purposes with company's name and telephone number. Vehicles shall incorporate signs, flaggers, and lights as needed for safety purposes.

PART 3 EXECUTION

3.1 VIDEO INFORMATION

A. **Audio**. Begin each video with an audio tract that includes the current date, project name, municipality, and general location, i.e., name of the street or property owner; location of cross county line; viewing side; and direction of progress. Note the engineering stationing (where required) on the audio track. Identify houses and buildings audibly by an address when available.

B. **Date and Time**. Display the month, day, year, hours, minutes, seconds, and location on all video recording.

C. **Stationing/Positioning**. Stationing must be continuous and accurate and reflect the stationing within the field of view. The stationing must coincide with stationing on project plans and utilize standard engineering notation (10+00). Global positioning system (GPS) may be used with or in place of engineering stationing. Differential GPSs are to be used where available, with updates one per second at 5-meter or less spherical accuracy. Standard GPS accuracy is as dictated by United Sates Department of Defense mandate. GPS display will be at 1-meter-longitude and 1-meter-latitude increments (4032 N 639) (08216 W 401).

3.2 COVERAGE

A. **General**. Recording shall include, but not be limited to:

1. Existing pavement.
2. Driveways.
3. Sidewalks.
4. Curbs.
5. Ditches (drainage patterns are of particular concern).
6. Streets (including condition of paving for full width).
7. Landscaping.
8. Shrubs.
9. Trees.
10. Culverts.
11. Catch basins.
12. Headwalls.
13. Fences.
14. Visible utilities.
15. All buildings (interior and exterior) located within the zone of influence of construction. Of particular concern are existing faults, fractures, defects, or other imperfections.

B. **Streets**. Record streets and street areas for the full width of the zone of influence of construction, including both sides of the street. The term "street" shall be understood to mean street, highway, avenue, boulevard, road, alley, lane, driveway, parking lot, etc., and all adjacent areas within the possible zone of influence of construction.

C. **Easements**. Record easements for the full width of the permanent and temporary easements and all other adjacent areas lying within the zone of influence of construction. Easement means all areas not in streets that require record coverage. Include in this coverage any areas that are intended to be used for construction access, storage, or waste disposal.

3.3 RECORDING CONDITIONS

A. **Visibility**. Record during times of good visibility. Do not record outside during the following conditions unless otherwise authorized:

1. Darkness.

2. During periods of visible precipitation.

3. When the ground area is covered with snow, leaves, or debris.

B. **Lighting**. In order to produce the proper detail and perspective, use adequate auxiliary lighting to fill in shadow areas, utility poles, road signs, and other such objects, as well as other conditions requiring artificial illumination.

C. **Rate of Speed**. Do not exceed an average rate of speed of 50 feet per minute during recording. Panning rates and zoom-in/zoom-out rates shall not exceed 10 percent over a 3-second interval.

D. **Distance**. When conventional wheeled vehicles are used for recording, the minimum distance from the camera lens to the ground shall be 8 feet.

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide all labor and materials necessary to furnish the following submittals as required by each individual section of the specifications.

1. Shop drawings.
2. Product data.
3. Samples/mock-ups.
4. Operation and Maintenance (O&M) manuals.
5. Personnel qualifications.
6. Training documents.
7. Source quality control documents.
8. Material field test reports.
9. Start-up documents.
10. Operational demonstration documents.
11. Product/material certifications.
12. Special warranties.
13. Project record documents.
14. Others (as specified in the individual technical specifications).

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS

A. **General**. Submit all submittals in accordance with the requirements within this specification section.

B. Submittal Package No. 1 – Submittal Schedule

1. Submit a submittal schedule of Submittals.

a. This schedule shall include all submittals that are required to be used on the project, and the date of submittal to the Engineer/Architect.

b. Include in schedule a milestone for notification of the Engineer/Architect prior to field-verifying operation and maintenance manuals.

c. Submittals requiring multiple submissions shall include multiple listings on the documents.

d. The Engineer/Architect will review the list and make any necessary comments.

e. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

f. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals concurrently.

g. Allow time in schedule for all submittals to go through the General Contractor for coordination purposes before they are forwarded to the Engineer/Architect.

h. Processing. Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals, depending upon the complexity of the submittal.

1. Allow 4 weeks for processing each submittal.

2. No extension of the Contract Time will be authorized because of failure to transmit submittals to the Engineer/Architect sufficiently in advance of the work to permit processing.

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Store and protect large samples and mock-ups** until the Project is completed, then properly dispose of off-site.

B. **Maintain and make available** to the Engineer/Architect, at the job site, a complete file of all approved submittals as part of the project record documents.

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 SUBMITTAL TRANSMITTAL

A. **Transmit each submittal** from the Contractor to Engineer/Architect using a transmittal form provided by the Engineer. The submittal shall be uploaded to a designated folder on a SharePoint site provided by the Engineer. The transmittal form shall include the following.

1. Relevant information and requests for data.

2. Deviations from Contract Document requirements, including minor variations and limitations.

3. The specification section number.

4. Other pertinent information to identify the items being submitted.

2.2 GENERAL REQUIREMENTS FOR SUBMITTALS

A. Originals

1. The Contractor, the subcontractors, or suppliers shall generate submittal information.

2. No reproductions of partial (or complete) versions of the plans, sections, details, schematics, specification pages, etc., from the Contract Documents are acceptable.

B. **Complete Submittals**. Clearly describe the equipment to be furnished with complete and detailed submittal information.

C. **Identification**. Properly identify all submittal-related documents and arrange in a logical order to best present the information. Provide an index that includes the following on every submittal.

1. Manufacturer's name and address.

2. Submittal date and revision number, if applicable.

3. Contract identification and specification section.

4. Drawing scale and orientation.

5. Submittal page number or sequence of pages.

6. Drawing number.

D. Verification

1. Where existing conditions or structures exist, field-verify dimensions, elevations, clearances, etc.

2. The submittal shall not be accepted for review until such verified data is clearly indicated.

E. Legends

1. All submittal diagrams, drawings, schematics, etc., shall include complete keys, legends or similar explanation as to the graphics, and symbols and abbreviations used.

2. In general, all graphics, symbols, abbreviations, and equipment nomenclature used for a submittal shall duplicate those used on the Contract Drawings.

F. **Approvals**. Provide the following on each submittal.

1. A space approximately 4" x 5" on to record the Contractor's review and approval markings and the action taken. These shall include the Contractor's:

a. Approval stamp.

b. Signature.

c. Date of approval.

d. Deviations from the Contract Documents.

2. An equal area beside the Contractor's review and approval markings for the Engineer/Architect's review stamp.

G. **One Section per Submittal**. Each submittal shall pertain to only one specification section.

H. All submittal information shall be:

1. Neatly arranged.
2. Legible.
3. Not distorted or faded.
4. English.
5. In United States standard units.
6. Typed.

I. **All letters, certifications, and similar documents** shall be submitted in their entirety. Single pages of multiple-page letters, or letters with deleted passages will not be acceptable for submittal purposes.

J. **Generic letters, test reports**, material certifications, or similar documents which do not specifically address the requirements of the Contract Documents for the actual materials being furnished will not be acceptable.

K. **Mark all submittals** to clearly indicate the full extent of the equipment to be furnished.

1. Indicate all options to be provided, materials of construction, dimensions, and other information pertinent to the submittal.
2. Options, materials, and dimensions which do not pertain to the materials or equipment to be furnished shall be neatly marked out so as to avoid confusion and doubt during review, delivery, and installation.

L. Resubmittals must clearly identify all changes and revisions.

1. The drawing shall be marked "revised" with the revision date indicated.
2. Each resubmittal shall reference the previous submittal by the Engineer/Architect's log number.

M. Definition of “By Others"

1. All submittals are reviewed as if prepared by the General Contractor.
2. The term "By Others" is appropriate to indicate supply by the Owner.
3. Where a subcontractor or supplier uses the term "By Others" to indicate work by the General Contractor or another subcontractor or supplier, the General Contractor shall change "By Others" to indicate the actual source.

N. **Deviations from Contract**. Highlight, encircle, or otherwise indicate deviations from the Contract Documents in all submittals.

2.3 SPECIFIC SUBMITTAL-TYPE REQUIREMENTS

A. **Shop Drawings**. The following paragraphs detail the general requirements for shop drawings and specific requirements for specific types of shop drawings.

1. General Requirements

a. A shop drawing is a detailed representation of the work to be performed to demonstrate compliance with the Contract Drawings including:

1. Material and equipment layout.
2. Fabrication drawings.
3. System and electrical schematic diagrams.
4. Equipment and material schedules.
5. Installation details.

b. Submit newly prepared information, drawn to accurate scale.

c. Standard information prepared without specific reference to the project is not considered shop drawings.

2. Equipment/Material Layout Drawings.

a. Include:

1. Plot plans.
2. Plant site maps.
3. Equipment location plans.
4. Equipment and material layout plans and sectional views.
5. Connection detail drawings.
6. Similar drawings showing the incorporation of materials and equipment into the work.
7. The physical layout to scale, including elevations, plant grid coordinates, dimensions to new/existing structures, and other items of the work.
8. Dimensions.
9. Labeling.
10. Notes.
11. Legends.
12. Bills of materials.
13. All other information required to graphically describe the proposed work.

3. System Schematics and Diagrams.

a. These include schematic representations of systems and equipment in a manner which shows the relative relationship of the components within the system and interconnections or interfaces with other systems or equipment.

b. These systems shall be shown on the most appropriate type and format of schematic diagram.

c. Diagrams shall identify all equipment and other components.

d. Indications shall be provided of system features such as flow directions, flow ranges, component sizes, capacities, settings, interlocks, component identification, and component or subsystem function.

e. Various types of systems for which schematic diagrams shall be required include:

1. Process Piping Systems.
2. Plumbing and Utility Piping Systems.
3. Heating and Air Conditioning Systems.
4. Ventilating Systems.
5. Pneumatic Systems.
6. Hydraulic Systems.
7. Conveying Systems.
8. Process and Chemical Feed Equipment Systems.
9. Electrical Distribution Systems.
10. Control Systems.
11. Alarm Systems.
12. Communication Systems.

f. In some instances, it may be appropriate to combine multiple types of system schematics onto a single drawing. In general, this practice would be appropriate for simple, self-contained systems and the adjacent subsystems and when required to clearly show system functionality.

B. **Product Data**. Product data is submittal information that fully describes the item to be incorporated into the work. Product data shall include when applicable:

1. Manufacturer name.
2. Catalog cut-sheets.
3. General descriptive bulletins/brochures/specifications.
4. Materials of construction data and parts list.
5. Finish/treatment data.
6. Equipment/material weight/loading data.
7. Power/utility requirements.
8. Engineering design data, calculations, and system analyses.
9. Digital system documentation.
10. Any deviations from the contract documents.
11. Material Certifications. These include signed certificates or declarations by the Contractor, supplier, manufacturer, testing laboratory, or recognized certification agency which document that materials and

product composition, or construction comply with specified requirements and stated reference standards.

12. Manufacturer's printed recommendations.

13. Compliance with recognized trade association and testing agency standards.

14. Application of testing agency labels and seals.

15. Notation of dimensions verified by field measurement.

16. Notation of coordination requirements.

17. Specific response to detailed specification requirements.

18. Maximum operating pressure and temperature ratings.

19. Other information specifically called for under the sections of Divisions 1 through 46 shall be included in this category.

C. Samples or Mock-Ups

1. Samples. Samples are portions of, or complete units of the precise article proposed to be furnished.

2. Color and Pattern Charts. When the precise color and pattern are not specifically prescribed in the Contract Documents, or when the Contract Documents require that a product be furnished in a color or pattern directed by the Owner or Owner's Representative, submit accurate color charts and pattern charts of the available ranges for review and selection.

3. Mock-Ups. Build mock-ups with full-size products to match the scale of the proposed construction to demonstrate compliance with specified requirements and construction standards.

D. O&M Manuals

1. General.

a. A complete Electronic Submittal shall be provided and shall be bookmarked by section.

b. Bind each copy in an appropriately sized three-ring notebook a cover designating the name of equipment, maintenance, and specification section number.

c. Bind operation and maintenance instructions for each specification section in a separate notebook.

2. Required Information. Include the following information to provide a description of the incorporation of the equipment into the work and with functional data to evaluate equipment operation.

a. Operation Sequence Descriptions. These shall:

1. Include complete, detailed written descriptions of the operating sequence of all control systems and operations in all modes.

2. Be specifically prepared for this work.

3. Be fully referenced to control diagrams and system components.

4. Include start-up and shut-down procedures and operations under manual, automatic, and emergency (alarm) conditions and any alternate operating modes.

5. Include operation of switches, lights, timers, relays, contacts, valves, motors, and equipment components.

6. Describe interlock functions including system safety functions.

b. Software/Programming Documentation.

1. Reference this documentation to the Operating Sequence Descriptions and include flow charts, program source codes listings, and documentation ladder diagrams with detailed descriptions for each rung of the software provided.

2. Provide information to instruct and to familiarize the operator with the system programming to enable a step-by-step evaluation of the program.

3. Provide notations, remarks, and labeling on the program source code listing to indicate the program operation and function.

4. Provide any additional narrative description of the program operation to fully describe the system parameters and functionality in a clear and logical manner.

c. Manufacturer's Instructions. Include:

1. Installation, routine preventive maintenance, troubleshooting, and lubrication instructions.

2. Procedures for moving, supporting, and anchoring of equipment, including tolerances for settings and adjustment.

3. Storage requirements to protect products prior to installation and during periods of prolonged shutdown.

4. Storage requirements of extra materials.

d. Parts List. Include assembly, exploded-view illustrations, or sectional drawings with all parts identified. Also include descriptions, quantity (per assembly) required, and original equipment manufacturer's part numbers.

e. Supplier Data. Provide addresses, telephone numbers, and names of contact persons for equipment manufacturer and manufacturer's representative. Include both regional (local) and home offices.

f. Warranties and Guarantees. Include copies of the approved draft warranties in the initial operation and maintenance manual

submittal. Following substantial completion, provide copies of the executed final warranties for insertion into the final operation and maintenance manuals.

g. Approved Submittals. Provide a complete list (including submittal numbers) of all approved submittals pertaining to the operation and maintenance instructions.

h. Copies of all materials shipped with the equipment.

i. Copies of all approved submittals including control wiring diagrams.

E. Personnel Qualifications

1. General. These qualification statements and information pertain to personnel and entities employed in the prosecution of the work.

2. Specific Information. Provide the following information regarding the proposed personnel or entity.

a. Education/training.

b. Company employment history.

c. Professional experience.

d. References.

e. Certifications or licenses.

f. Stated qualifications shall be pertinent to the specific task for which qualifications are requested.

F. Training Documents

1. Instructors' Qualifications. See paragraph 2.3 E.

2. Proposed schedule for the training sessions.

3. Lesson Plan. Lesson plans shall:

a. Be O&M manual-based.

b. Cover all components of each system regardless of source of supply or manufacturer.

c. Detail the instructional objective statement on the goal(s) intended to be achieved by the end of the training session.

d. Indicate the category of training (operation, maintenance, and electrical instrumentation); describe the session including length and type (classroom or field) and the instructor.

4. One copy of all instructional material to be used during training.

5. A sign-in sheet containing the signature of each attendee, training topic, and date after the training is completed.

G. Source Quality Control Documents

1. Inspection.

a. Inspection data includes inspection procedures and results of factory inspections of products, equipment, or systems.

b. Within this type of submittal information are factory witness test procedures, schedules and reports, and similar data.

2. Testing.

a. Test data is the information leading to or resulting from tests performed on materials, equipment, or systems at the manufacturer's facilities or in testing laboratories.

b. This also includes data on testing equipment.

c. Examples of test data include all information, test arrangement, drawings, illustrations, diagrams, curve plots, graphs, and other data which substantiates or establishes a material or product characteristic, quality, or other trait as a result of test required by the Contract Documents.

H. Material Field Test Reports

1. Report Data. Written reports of each inspection, test, or similar service shall include, but not be limited to:

a. Date of issue.

b. Project title and number.

c. Name, address, and telephone number of testing agency.

d. Dates and locations of samples and tests or inspections.

e. Names of individuals making the inspection or test.

f. Designation of the work and test method.

g. Identification of product and specification section.

h. Complete inspection or test data.

i. Test results and interpretations of test results.

j. Ambient conditions at the time of sample taking and testing.

k. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.

l. Name and signature of laboratory inspector.

m. Recommendations on testing.

2. Example reports covered by this paragraph include compaction tests and concrete, leakage, and disinfection tests.

I. Start-Up Documents

a. Start-Up Request. Start-up requests shall include the following:

b. Qualifications of Manufacturer's Representative. See paragraph 2.3 E.

c. Field Test Procedures.

1. List of materials and equipment necessary for testing.

2. Calibration. Certification of calibration of all test instruments used.

3. Test Form Report. Copy of testing results report form.

d. Proposed start-up schedule including all field testing.

2. Manufacturer's Representative's Reports.

a. Each manufacturer's representative shall prepare a report on every site visit for each system or item of equipment inspected, adjusted, started up, or worked on.

b. If a manufacturer's representative visits the site for equipment specified in several specification sections, a separate report shall be filed for each specification section.

c. The report shall state:

1. The purpose of the visit.

2. The representative's observations and conclusions.

3. Recommendations for further visits or action.

4. A tabulation or log of the settings of all adjustable components.

a) Initial settings shall be recorded and submitted on the first visit.

b) During subsequent visits, the manufacturer's representative shall add the current or adjusted setting to the tabulation or log.

5. Include manufacturer's certification that equipment being tested has been inspected with regard to conformance to the plans, specifications, and shop drawings and that it has been tested and is ready for operational demonstration.

6. All test reports for all required field testing.

J. Operational Demonstration Documents

a. Operational Demonstration Request. Include the following:

b. Name, address, and telephone number of all representatives during the operational demonstration.

c. Sample operational demonstration log for Engineer/Architect review.

2. Operational Demonstration Log.

a. An operational demonstration log is a continuous chronological record of operational status of the system and equipment.

b. Include all changes in status or system parameters, adjustments, and results of tests.

c. Make entries, noting the date and time, at the occurrence of each event.

d. Use acceptable operational demonstration log forms.

K. Special Warranties

1. There are two general types of warranties covered by this specification.
    a. Manufacturer's Express Warranties.
        1. These are formal statements of certifications by manufacturers which warrant to the Owner that products and equipment are free from defects in material and workmanship.
        2. These are standard warranties issued with products and equipment which supplement the Contractor's warranty and may also extend coverage past the expiration of the Contractor's warranty.
        3. Include with the manufacturer's warranty data shall be a notification of the availability of an extension to the standard warranty including terms.
    b. Special Express Warranties.
        1. The form, format, and conditions of special warranties are described in the various specification sections of the Contract Documents.
        2. These are formal warranties above and beyond the Contractor's warranty and manufacturer's standard warranties.
        3. These warranties may be based on performance, power consumption, maintenance projects, or other operating parameters.
        4. Extended warranties, service contracts, and performance bonds are also included under this category.
2. Term or Period. Unless otherwise established by individual sections in Divisions 2 through 46, all Contractor express warranties shall extend for 1 calendar year from the date of substantial completion of the project or acceptance date of the product or portion of work thereof, whichever is the later date.
3. Content of Warranty. The warranty shall contain, as applicable:
    a. Effective starting date of the warranty period.
    b. Statement of the terms and conditions of the warranty, if any.

L. Project Record Documents

1. Contractor shall maintain in a safe place at the Site **one record copy** of all Drawings, Specifications, Addenda, Approved Shop Drawings, Change Orders, Work Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings shall be delivered to Engineer for Owner.
2. Record Contract Drawings. Legibly mark contract drawings to record actual construction including:

a. Depths of various elements of foundation in relation to data.

b. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.

c. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.

d. Field changes of dimension and detail.

e. Changes made by change order or work order.

M. Extra Materials/Spare Parts

1. Coat or package extra materials to prevent corrosion or deterioration during long-term indoor storage.

2. Clearly label all packaging with:

a. Part name.

b. Part number.

c. Associated equipment name and number.

d. Manufacturer's name and address.

e. The required storage environment for the materials.

N. **Other**. These include special tools/repair parts list, photographs, videos, certificates, construction schedules, drawings, reports, meeting minutes, data, and information required by the Contract Documents which do not logically fall into the submittal types defined above.

PART 3 EXECUTION

3.1 SUBMITTAL PREPARATION AND TRANSMITTAL

A. Coordination

1. Coordinate preparation and processing of submittals with performance of construction activities.

2. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay and in accordance with the submittal schedule.

3. The General Contractor is responsible for resolving any disputes between Subcontractors over submittals.

B. Verification

1. Verify the correctness and completeness of all submittals prior to forwarding same for review.

2. All submittals shall comply with the Contract Documents.

C. **Package each submittal** appropriately for transmittal and handling including a transmittal form.

D. **The General Contractor shall submit** the minimum number of submittals as listed in paragraph 3.3 of this specification.

E. **Submittals received from sources** other than the General Contractor will be returned without action.

F. **Subcontractors shall submit** all submittals through the General Contractor.

3.2 ENGINEER/ARCHITECT'S REVIEW AND ACTION

A. General

1. Except for submittals for record, information, or similar purposes where action and return is not required or requested, the Engineer/Architect will review each submittal, mark to indicate action taken, and return promptly.

2. Cost to review any submittal more than twice will be deducted from Contractor's monthly estimates and final payments.

3. The Engineer/Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. **Action Stamp**. The Engineer/Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate action taken.

1. Final Unrestricted Release. Where submittals are marked "Approved," that part of the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.

2. Final-but-Restricted Release. When submittals are marked "Approved as Noted," that part of the work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance. If the submittal is marked as requiring additional information, the submittal will not be closed until the requested information is submitted and acknowledged.

3. Returned for Resubmittal.

a. When submittal is marked "Not Approved" and/or "Revise and Resubmit," do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity.

b. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary, to obtain a different action mark.

c. Do not permit submittals marked "Not Approved" and/or "Revise and Resubmit" to be used at the project site or elsewhere where work is in progress.

3.3 MINIMUM NUMBER OF SUBMITTALS AND DISTRIBUTION

A. **Electronic and Hard Copy Submittals**. The Contractor shall provide all submittals in electronic format for review and approval. All electronic files shall be bookmarked as applicable. The Engineer will make available a SharePoint site where the Contractor can submit documents electronically for review and approval. The Contractor shall provide hard copies of approved documents for the Owner/Engineer. After a submittal has been approved, the Contractor shall provide the following minimum number of submittals **in addition to the electronic file** that shall be uploaded to the SharePoint site:

Submittal	**Minimum No. of Hard Copies**
Approved Shop Drawings	1 (Stored on-site once approved)
Product Data	0
Samples/Mock-Ups	1
O&M Manuals	1
Personnel Qualifications	1
Training Documents	2
Source Quality Control Documents	2
Material Field Test Reports	2
Start-Up Documents	2
Operational Demonstration Documents	2
Special Warranties	1
Project Record Documents	1
Extra Materials	1
Others	0

3.4 SPECIFIC SUBMITTAL-TYPE EXECUTION REQUIREMENTS

A. O&M Manuals

1. Submittal Procedure. Submit one initial copy of the O&M manual for review that is bookmarked by section. After approval of the initial copy, submit the remainder of the revised manuals.

2. Verification. Verify the accuracy of the initial O&M manual by visual and physical inspection of the installed equipment during start-up.

   a. Perform field verification in the presence of the Owner or Owner's Representative.

   b. Physically trace and document as required all wiring and piping.

   c. Visually inspect equipment and components and compare configurations and nameplate information to O&M manual.

   d. Make any changes, additions, or deletions to the O&M manual identified during field verification.

e. In the event changes are made to the equipment following field verification, submit a final supplement of the revisions of the O&M manuals before approval.

B. Sample Panels

1. Construct any required sample panels on-site.

2. Construct sample panels only after the individual samples and components used in the sample panel have been approved.

3. If a sample panel does not conform to the Contract requirements, construct additional ones until conformance is achieved.

C. **Samples for Tests**. Furnish samples of material as may be required for examination and test. Take all samples of materials for tests according to standard methods or as provided in the Contract Documents.

END OF SECTION

SECTION 01 35 26

HEALTH AND SAFETY PROVISIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to protect all persons on or near the premises from unreasonable risks of injury that arise during or as a result of this work in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with the plans and as specified herein.

B. Standards

1. Manual of Accident Prevention in Construction published by Associated General Contractors of America.

2. Occupational Safety & Health Administration's (OSHA's) confined-space entry procedures.

3. Applicable state or federal occupational health and safety standards.

4. Other reasonable safety rules and practices established.

1.4 SUBMITTALS (Not Used)

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 SAFETY COORDINATOR

A. Contractor shall provide a person who, in addition to their other construction duties, will act as the safety coordinator for the work of this contract including but not limited to health and safety considerations associated with the work. The safety coordinator shall have experience in safety and health aspects of construction work, shall work on improving the safety and health of people involved in, and in the proximity of, the work of this Contract, and be on the job site during all normal work hours. The safety coordinator shall cooperate with the site Lead Safety Coordinator if one is designated by the Owner's Representative.

3.2 SAFETY PROGRAM

A. Contractor's safety coordinator shall establish a safety program for the job site, the safety program shall include:

B. **A list of general and specific** safety guidelines for each trade.

C. **A training program for instructing each worker** to recognize and avoid unsafe conditions and to apply good safety and health practices.

D. A system for ensuring that machinery and equipment are operated only by qualified people.

E. **A system for tagging and removing** unsafe machinery, equipment, tools, and goods.

F. **A system for investigating each injury** and reporting its cause and the steps taken to prevent recurrence to the Owner.

G. **A system for implementing use** of personal protective equipment, as necessary.

3.3 SAFETY PROGRAM REVIEW

A. Contractor shall review the safety program with the Owner's Representative before commencement of any activity on the job site.

3.4 CONFINED SPACE ENTRY

A. Anyone entering storage tanks or similarly confined areas shall comply with OSHA's Confined Space Entry Regulations.

END OF SECTION

SECTION 01 50 00

TEMPORARY CONSTRUCTION SERVICES AND FACILITIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and material necessary to furnish, install, and maintain the temporary construction services and facilities in accordance with these plans and specifications. Temporary construction services and facilities include the following.

1. Temporary utilities required include, but are not limited to:
    a. Water service and distribution.
    b. Temporary electric power and light.
    c. Internet and cell service
    d. Storm and sanitary sewer.
2. Temporary construction and support facilities required include, but are not limited to:
    a. Gravel for walkways and temporary parking.
    b. Temporary heat.
    c. Field offices and storage sheds.
    d. Temporary roads and paving.
    e. Sanitary facilities, including drinking water.
    f. Temporary enclosures.
    g. Temporary project identification signs and bulletin boards.
    h. Waste disposal services.
    i. Construction aids and miscellaneous services and facilities.
    j. Dewatering facilities and drains.
    k. Rodent and pest control.
3. Security and protection facilities required include, but are not limited to:
    a. Temporary fire protection.
    b. Barricades, warning signs, lights.
    c. Enclosure fencing for the work area.
    d. Environmental protection.

1.3 QUALITY ASSURANCE

A. **Regulations**. Comply with industry standards and with applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, fire department, and rescue squad rules.
5. Environmental protection regulations.

B. **Standards**. Comply with National Fire Protection Association (NFPA) Code 241, "Building Construction and Demolition Operations"; American National Standards Institute (ANSI) A10 Series standards for "Safety Requirements for Construction and Demolition"; and National Electrical Contractors Association (NECA) Electrical Design Library "Temporary Electrical Facilities."

1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services" prepared jointly by Associate General Contractors of America (AGC) and Adhesive and Sealant Council, Inc. (ASC) for industry recommendations.
2. Electrical Service. Comply with National Electrical Manufacturers Association (NEMA), National Electrical Contractors Association (NECA), and Underwriters' Laboratories, Inc. (UL) standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NEC) (NFPA 70).

C. **Inspections**. Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits and keep on file for Owner review.

1.4 SUBMITTALS (Not used)

1.5 JOB CONDITIONS

A. Conditions of Use

1. Keep temporary services and facilities clean and neat in appearance.
2. Operate in a safe and efficient manner.
3. Take necessary fire-prevention measures.
4. Do not overload facilities.
5. Do not allow hazardous, nuisance, or unsanitary conditions to develop or persist on the site.
6. Do not permit facilities to interfere with progress.
7. The installer of each permanent service or facility shall assume responsibility for its operation, maintenance, and protection during its use as a construction service or facility prior to the Owner's acceptance, regardless of previously assigned responsibilities.
8. At the earliest feasible time, when acceptable to Owner, change over from use of the temporary service to use of the permanent service.

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

1.8 DIVISION OF RESPONSIBILITIES

A. General

1. The General Contractor is assigned specific responsibilities for certain temporary services and facilities used by other subcontractors and other entities at the site.

2. The General Contractor is responsible for providing temporary services and facilities that are:

a. Not normal construction activities of other Prime Contractors.

b. Not specifically assigned otherwise in the Contract Documents.

c. Listed as a responsibility for another Prime Contractor that does not exist on this project.

B. The General Contractor is responsible for:

1. Installation, operation, maintenance, and removal of each temporary service or facility usually considered as its own normal construction activity.

2. Plug-in electric power cords and extension cords, and supplementary plug-in task lighting and special lighting necessary exclusively for its own activities.

3. Its own field office, complete with necessary furniture, utilities, internet service, cell service, computer, and printer.

4. Access to record documents as described in Section 01 33 00 – Submittals.

5. Its own storage and fabrication sheds.

6. Temporary heat, ventilation, humidity control, and enclosure of the building where these utilities are necessary for its construction activity, but where these utilities have not yet been installed.

7. Special or unusual hoisting requirements, including hoisting loads in excess of 2 tons, hoisting material or equipment into spaces below grade, and hoisting requirements outside the building enclosure.

8. Collection and disposal of its own hazardous, dangerous, unsanitary, or other harmful waste material.

9. Secure lockup of its own tools, materials and equipment.

10. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.

11. Temporary internet and cell services.

12. Temporary roads and paving.

13. Temporary toilets, including disposable supplies.

14. Temporary wash facilities, including disposable supplies.

15. Containerized bottled water type drinking water units.
16. Temporary enclosure of the building.
17. Project identification and temporary signs.
18. General collection and disposal of wastes.
19. Barricades, warning signs, and lights.
20. Enclosure fence.
21. Security enclosure and lockup.
22. Environmental protection.
23. Temporary water service.
24. Temporary heat.
25. Temporary heat, upon enclosure of the building.
26. Temporary ventilation, upon enclosure of the building.
27. Temporary electric power service and distribution.
28. Temporary lighting.
29. Connections for illuminated signs.

1.9 USE CHARGES

A. **General**. The Contractor will be responsible for usage charges for temporary utilities. These utilizes include water service, electric power service, internet service , cell service, and electric for temporary heat.

B. **Other entities using temporary services** and facilities include, but are not limited to:

1. Subcontractors.
2. The Owner's work forces.
3. Occupants of the project.
4. The Engineer/Architect.
5. Testing agencies.
6. Personnel of government agencies.

PART 2 PRODUCTS

2.1 MATERIALS

A. **General**. Provide new or acceptable previously used materials. Provide materials suitable for the use intended.

B. **Open Mesh Fencing**. Provide 11-gauge, galvanized 2-inch, chain-link fabric fencing 6 feet high with galvanized barbed wire top strand and galvanized steel pipe posts, 1-1/2-inch inside diameter (I.D.) for line posts, and 2-1/2-inch I.D. for corner posts.

2.2 EQUIPMENT

A. **General**. Provide new or acceptable previously used equipment. Provide equipment suitable for the use intended.

B. Fire Extinguishers

1. Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces.

2. In other locations provide hand-carried, portable, class "ABC" dry-chemical extinguishers, or a combination of extinguishers of NFPA recommended types for the exposures.

3. Comply with NFPA 10 and 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 EXECUTION

3.1 INSTALLATION

A. **Use qualified personnel** for installation of temporary facilities.

B. **Location**. Coordinate location with Owner and Engineer/Architect. Locate facilities where they serve the project adequately and result in minimum interference with performance of construction activities. Relocate facilities as required.

C. **Provide each facility ready for use** when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. **General**. Engage the appropriate local utility company to install temporary service or connect to existing service per Section 01 00 00 General Requirements Part 3.9 Utilities. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.

B. **Water Service**. Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use. Disinfect temporary water piping prior to use.

C. Temporary Electric Power Service

1. Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction.

2. Include meters, transformers, overload protected disconnects, automatic ground fault interrupters, and main distribution switch gear.

3. Power Distribution System. Install wiring overhead, and raise vertically where least exposed to damage. Where permitted, wiring circuits not

exceeding 125-Vac 20-ampere rating and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Lighting

1. Whenever an overhead floor or roof deck has been installed, install temporary lighting with local switching.

2. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire lighting system, and will provide adequate illumination for construction operations and traffic conditions.

E. Temporary Internet and Cell Service

1. Provide temporary internet and cell service for all personnel engaged in construction activities, throughout the construction period.

2. Install telephone on a separate line for each temporary office and first aid station.

3. At each telephone, post a list of important telephone numbers.

F. Sewers and Drainage.

1. If sewers are available, provide temporary connections to remove influent that can be discharged lawfully.

2. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities.

3. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off the site in a lawful manner.

4. Filter out excessive amounts of soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.

5. Connect temporary sewers to the municipal system as directed by the sewer department officials.

6. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.

G. **Provide earthen embankments and similar barriers** in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Temporary Heat

1. Provide temporary heat required by construction activities, for curing or drying of completed installations, or protection of installed construction from adverse effects of low temperatures or high humidity.

2. Select safe equipment that will not have a harmful effect on completed installations or elements being installed.

3. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

4. Provide properly vented self-contained electric or fuel oil heaters with individual space thermostatic control.

5. Do not use gasoline-burning space heaters, or open-burning or salamander-type heating units.

B. Field Offices

1. Provide an insulated, weathertight, heated, or air-conditioned temporary office of sufficient size to accommodate required office personnel at the project site.

2. The General Contractor shall provide, either as a part of its field office or as a separate facility, a room of not less than 240 square feet (sf) for project meetings.

3. Furnish the room with a conference table, eight folding chairs, and a tackboard.

4. Keep the office clean and orderly.

C. **Storage and Fabrication Sheds**. Install storage and fabrication sheds, sized, furnished, and equipped to accommodate materials and equipment including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.

D. **Sanitary facilities include** temporary toilets, wash facilities, and drinking water fixtures.

1. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities.

2. Install where facilities will best serve the project's needs.

3. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.

4. Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.

5. Provide bottled-water-type drinking water units.

6. Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. **Temporary Enclosures**. Provide temporary enclosure for protection of construction in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely, with fire-treated wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load bearing wood framed construction.

F. Project Identification and Temporary Signs

1. Project Identification Signs. See Section 01 58 13, "Project Sign," for additional requirements.

2. Temporary Signs. Prepare signs to provide directional information to construction personnel and visitors.

3. Support on posts or framing of preservative-treated wood or steel.

4. Do not permit installation of unauthorized signs.

G. **Temporary Site Lighting**. Install exterior yard and sign lights so that signs are visible when work is being performed.

H. **Collection and Disposal of Waste**. See Section 01 74 23, "Cleaning."

I. Stairs

1. Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

2. Cover finished permanent stairs with a protective covering of plywood or similar material so finishes will be undamaged at the time of acceptance.

J. Rodent and Pest Control

1. Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests.

2. Employ this service to perform extermination and control procedures at regular intervals so the project will be relatively free of pests and their residues at Substantial Completion.

3. Perform control operations in a lawful manner using environmentally safe materials.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. **General**. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer as requested.

B. Temporary Fire Protection

1. Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses.

2. Comply with NFPA 10, "Standard for Portable Fire Extinguishers," and NFPA 241, "Standard for Safeguarding Construction, Alterations and Demolition Operations."

3. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

4. Store combustible materials in containers in fire safe locations.

5. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires.

6. Prohibit smoking in hazardous fire exposure areas.

7. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. **Permanent Fire Protection**. At the earliest feasible date in each area of the project, complete installation of the permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

D. Barricades, Warning Signs, and Lights

1. Comply with standards and code requirements for erection of structurally adequate barricades.

2. Paint with appropriate colors, graphics, and warning signs to warn personnel and the public of the hazard.

3. Where needed, provide lighting including flashing lights.

E. Enclosure Fence

1. When excavation begins, install an enclosure fence with lockable entrance gates.

2. Locate where indicated, or enclose the portion determined sufficient to accommodate construction operations.

3. Install in a manner that will prevent people and animals from easily entering the site, except by the entrance gates.

4. Provide open-mesh, chain-link fencing with posts set in a compacted mixture of gravel and earth.

F. Security Enclosure and Lockup

1. Install substantial temporary enclosure of partially completed areas of construction.

2. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

3. Storage of Valuable Material. Where materials and equipment must be stored and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

G. Environmental Protection

1. Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil

might be contaminated or polluted, or that other undesirable effects might result.

2. Avoid use of tools and equipment which produce harmful noise.

3. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

A. **Supervision**. Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance

1. Maintain facilities in good operating condition until removal.

2. Protect from damage by freezing temperatures and similar elements.

3. Maintain operation of temporary construction services and facilities on a 24-hour-day basis where required to achieve indicated results and to avoid possibility of damage.

4. Prevent water filled piping from freezing. Maintain markers for underground lines.

5. Protect from damage during excavation operations.

C. Termination and Removal

1. Unless requested that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion.

2. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility.

3. Repair damaged work, clean exposed surfaces, and replace work which cannot be satisfactorily repaired.

4. Materials and facilities that constitute temporary facilities are property of each Prime Contractor. The Owner reserves the right to take possession of project identification signs.

5. Temporary Pavement.

a. Remove temporary paving that is not intended for or acceptable for integration into permanent paving.

b. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area.

c. Remove materials contaminated with road oil, asphalt and other petrochemical compounds and other substances which might impair growth of plant materials or lawns.

d. Repair or replace street paving, curbs, and sidewalks at the temporary entrances, as required by the governing authority.

6. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:

   a. Replace air filters and clean inside of ductwork and housings.

   b. Replace significantly worn parts and parts that have been subject to unusual operating conditions.

   c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION

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SECTION 01 52 13

FIELD OFFICE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to furnish and maintain field office facilities in accordance with the drawings and specifications.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS (Not used)

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 FIELD OFFICE

A. **Description**. The General Contractor shall provide a furnished field office for the exclusive use of the Engineer/Architect as specified herein.

B. **Location**. Position the field office in an acceptable location.

C. **Size**. The field office shall contain a minimum of 24 feet x10 feet of floor space.

D. **Utilities**. Provide lighting, heating, air conditioning, and an independent telephone.

E. **Equipment**. Provide and maintain the following furnishings and equipment.

1. One 3" x 5" drafting table and stool.
2. Two office desks and chairs.
3. One plan rack.
4. One storage closet, suitable for surveying equipment and testing equipment.
5. Two four drawer legal size file cabinet.
6. Ten folding chairs and one 8’ folding table.
7. One broom, and two wastebasket.
8. One Hewett-Packard Office Jet Color Ink Printer All-In –One printer with USB connection to PC, 8-1/2” x 14” printing capability or approved substitute of equal specifications. Printer shall be provided, with one installed and one spare set of ink cartridges.

9. Internet access for file transfer (ftp), web browsing, and email must be supplied via an independent DSL phone line (or comparable high speed connection, with all installation of service, router, 4 port switch, and 10' Ethernet cables, operation fees assumed by General Contractor, including monthly service for period that the field office is being used.

10. Compact refrigerator (mini-fridge); 3.2 cubic feet minimum.

11. Microwave over with minimum of 1.3 cubic feet and 1,000 watt minimum.

12. One (1) boot scraper shall be equipped at each entrance location to the field office.

F. **Security**. Provide security measures against fire, theft, and other damages.

G. **Safety Items**. Provide the following items for the exclusive use of the Engineer/Architect.

1. First aid kit meeting Occupational Safety and Health Administration (OSHA) requirements.

2. List of emergency numbers placed permanently adjacent to the telephone which shall include fire department, life squad, police, Ohio Environmental Protection Agency (EPA), and OSHA.

PART 3 EXECUTION

3.1 INSTALLATION

A. Furnish the field office for occupancy within 30 days of Notice to Proceed but no later than start of construction.

3.2 CLEANING AND MAINTENANCE

A. **Cleaning**. Arrange for weekly cleaning of the field office.

B. **Maintenance**. Maintain the field office in proper working order throughout the construction.

3.3 REMOVAL

A. The facilities shall remain available throughout the duration of the project. Remove these facilities from the site within 30 days of notification.

END OF SECTION

SECTION 01 55 27

INTERFERENCE WITH TRAFFIC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to maintain traffic in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in the maintenance of traffic in compliance with applicable requirements of governing agencies having jurisdiction.

B. **Maintenance of Traffic**. The maintenance of traffic shall be in accordance with the Manual of Uniform Traffic Control Devices.

1.4 SUBMITTALS (Not Used)

1.5 JOB CONDITIONS

A. **Owner Requirements**. If proper maintenance of traffic facilities and proper provision for traffic control are not being provided and the safety of the public is thus endangered, the Owner may take the necessary steps to place them in proper condition and the cost of such services will be deducted from any payment which may be due or become due the Contractor.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 DESCRIPTION

A. The Contractor shall furnish, erect, maintain, and remove lights, signs, barricades, temporary guardrails, other traffic control devices, and furnish watchmen and flagmen as may be necessary to maintain safe traffic conditions.

3.2 MAINTAINING TRAFFIC

A. **Traffic Diversion**. Whenever it is necessary to divert traffic from its normal channel into another channel, such diversion shall be clearly marked by cones, drums, barricades, or temporary guardrail. If the markers are left in place at night, suitable lights shall be provided and maintained.

B. **One-Way Traffic**. Whenever one-way traffic is established, at least two flagmen shall be used.

3.3 CLOSED TO TRAFFIC

A. **Street Closing**. The Contractor may close the street to through traffic for minimum periods of time with proper notice to local occupants of all premises, police and fire protection authorities, and other public authorities as applicable. The Contractor shall so schedule his work that this time is a minimum and shall, whenever possible, make suitable provision for access by local residents, school buses, and mail delivery vehicles. The Contractor shall provide access for police, fire, and emergency vehicles at all times. Fire hydrants and other public utility valves shall be accessible at all times.

B. **Detours**. When it is required that the street or road be closed to traffic, the Contractor shall furnish, erect, maintain, and remove barricades, suitable and sufficient red lights, and other lights or reflecting material at the limits of the project, where side streets intersect, and at other points of public access to the project. The Contractor shall furnish, erect, and maintain advance warning signs and barricades on side streets at the first street intersection beyond the one closed by construction indicating "Street Closed, One Block Ahead." The Contractor shall furnish, erect, maintain, and remove detour marking signs on temporary routes.

END OF SECTION

SECTION 01 57 13

SEDIMENT AND EROSION CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to work in this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide all labor, tools, equipment, and materials necessary to furnish and maintain the soil erosion controls where shown, where shown on the Contractor's Storm Water Pollution Prevention Plan (SWP3), where directed, and as specified herein.

B. **SWP3 Preparation**. Prepare an SWP3 for this project, obtain necessary permits, provide dust control, and terminate coverage under the permits, if necessary, upon completion of the work.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work required in the control of erosion during construction in compliance with the following standards as referenced herein:

1. ODOT – Ohio Department of Transportation. Construction and Material Specifications (most recent edition).

2. ODNR – Ohio Department of Natural Resources. "Rainwater and Land Development Ohio's Standards for Stormwater Management Land Development and Urban Stream Protection" (Rainwater and Land Development) current edition.

3. Ohio EPA – Ohio Environmental Protection Agency.

a. National Pollutant Discharge Elimination System (NPDES) Permit No. OHC000002, "Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System" (General NPDES Permit).

B. **Conflicts**. In the event of a conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, regulations, or standards shall apply.

1.4 SUBMITTALS

A. **General**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – SWP3 and Notice of Intent (NOI) Form (as needed)

1. Submit the Contractor's SWP3 including associated drawings and details of sediment and erosion control measures that will be employed during the project.

1.5 JOB CONDITIONS

A. Construction Sites Less than 1 Acre

B. SWP3. Develop and implement an SWP3 for the control of sediment and erosion at this project site throughout construction. At a minimum the SWP3 shall include the following:

C. Site drawing showing the limits of all earth-disturbing activities, location of proposed temporary access roads or stockpiles, and location of all proposed sediment and erosion control features (i.e., silt fencing, sediment basins, temporary seeding, etc.). Include details for installation and material specifications for each erosion control feature.

D. Written description of the proposed sediment and erosion control measures that will be employed, including a schedule for installation and removal of temporary controls as they are related to actual site construction. Also include information regarding site soils, any permanent or temporary seeding, an inspection and maintenance schedule, and all measures that will be employed by any subcontractors.

E. **Sediment and Erosion Control Shown on the Plans**. The sediment and erosion control measures shown on the plans, if any, are considered to be the minimum level of control required. Prepare the final SWP3 and use, if appropriate, alternate methods and locations of sediment and erosion control to meet the site requirements provided they are approved.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. Handle all sediment and erosion control materials in accordance with the manufacturer's recommendations.

B. **Storage**. Store all seeds for temporary seeding in a safe, dry location protected from weather conditions that may affect the seed viability.

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 GENERAL

A. The SWP3 shall incorporate some or all of the following equipment and materials for sediment and erosion control measures, as appropriate. Alternative materials and methods as presented in ODOT Item 832 or ODNR's Rainwater and Land Development manual may be considered.

B. **Sediment Barriers**. Sediment barriers are temporary measures using woven wire or other approved material attached to posts with filter cloth of burlap and plastic filter fabric to intercept, detain, and control sediment and erosion from leaving the construction site.

1. Filter Fabric/Silt Fence. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester, or ethylene yarn. Fabric shall be ODOT Item 712.09, Type C or equal.

2. Wire Fencing. Wire fence reinforcement for silt fences at storm drain inlets shall be a minimum of 42 inches in height and a minimum of 14 gauge, and shall have a maximum mesh spacing of 6 inches.

3. Silt Fence Posts. Posts for silt fences shall be either 2-inch-by-2-inch hardwood or equivalent steel with a minimum length of 32 inches. Steel posts shall have projections for fastening wire to them.

4. Storm Drain Inlet Protection Framing. Stakes and framing for yard, drainage ditch, or parking lot inlet protection shall be 2-inch-by-4-inch wood (preferred) or equivalent metal with a minimum length of 3 feet for the stakes/posts.

C. **Matting**. Matting shall be agricultural straw or coconut fiber within photodegradable netting, jute, excelsior, or approved equal synthetic material as specified in ODOT Items 671 and 712.11.

D. **Temporary Seeding and Mulching**. Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting used to reduce erosion. All cut-and-fill slopes including borrow pits shall be seeded and/or mulched where and when necessary to eliminate erosion.

1. Materials. Mulch.

a. Straw. Straw mulch shall be unrotted small-grain straw, free of sticks or other foreign material.

b. Wood Cellulose Fiber. Wood cellulose fiber mulch shall be dyed green and not inhibit seed germination.

2. Fertilizer. Fertilizer shall contain 12 percent total nitrogen, 12 percent available phosphoric acid, and 12 percent water-soluble potash. The name of plant nutrients, weight, and quarantined percentages shall be marked on the sealed containers.

E. **Sediment Structures**. Sediment basins, dams, and dikes are prepared storage areas to trap and store sediment from construction areas and to protect properties and stream channels below the construction areas from siltation.

F. **Rock Channel Protection**. Aggregate for the rock channel protection, dams, erosion control, or other uses indicated on the drawings, shall be provided in accordance with ODOT Item 601. Gradation/type shall be as noted on the drawings.

PART 3 EXECUTION

3.1 GENERAL

A. **Examination**. Inspect the existing and proposed site drainage patterns in order that the most efficient methods of erosion control may be selected through the duration of construction.

B. **Fill material and equipment storage** is prohibited within 200 feet of the stream bank, in the floodplain, in wooded areas, or in other environmentally sensitive areas. Dispose of surplus excavated materials off-site.

C. **Maintenance**. Be responsible for ongoing inspection and maintenance of the sediment and control features. At a minimum, complete an inspection log at least every 7 calendar days and within 7 days of each rainfall event. Repair/replace damaged features.

D. **Dust Control**. Minimize dust generation, including wetting down unpaved areas during the construction activities.

3.2 PREPARATION

A. General

1. Limit the surface area of erodible earth material exposed by the clearing and grubbing, excavation, borrow, and fill operations and provide immediate permanent or temporary control measures to prevent contamination of adjacent streams or other water courses, lakes, ponds, or other areas of water impoundment.

2. Such work will involve the construction of temporary ditch checks, filters, benches, dikes, dams, sediment basins, and slope drains, and use of temporary mulches, mats, seeding, or other control devices or methods necessary to control erosion and sedimentation.

3. Prepare and submit an SWPPP in advance of the work.

4. Limit the area of excavation, borrow, and embankment operations in progress commensurate with capability.

5. Deliver sediment and erosion control materials at appropriate times so that the project is not delayed.

6. Do not commence with any earth-disturbing activity until the appropriate sediment and erosion control features are in place.

B. **Sediment and Erosion Control Devices**. Minimization of denuded areas and the length of time that any area is denuded is the primary method of sediment and erosion control at any site. Adequate scheduling and the use of permanent and temporary seeding or mulching as described in paragraph 3.3 can accomplish this.

1. Areas that are to be denuded shall have structural control measures in place prior to exposure of the soil and such measures shall remain until the area is established and permanent measures are in place. In the case of silt fencing, which may require the rough grading to be completed prior to installation, it shall be installed as soon as practical. Structural measures shall include at a minimum:

a. Sediment basins for all drainage areas greater than 5 acres.

2. Aggregate construction entrances at all points of construction traffic egress from the site onto pavement.

3. Silt fencing at all areas of sheet flow.

4. Inlet protection at all storm water inlets.

5. Matting at all slopes greater than 3:1 and drainage swales/ditches.

6. Sediment traps or basins at all drainage areas that can not be adequately protected with silt fencing as determined by the Contractor developing the SWPPP.

7. Silt fencing around soil stockpiles or cover them with tarps.

3.3 EROSION CONTROL

A. Permanent Erosion Control

1. Incorporate all permanent erosion control features into the project at the earliest practicable time.

2. Perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available.

3. Establish final grades and application of fertilizer, seed, and mulch.

4. Maintain sediment barriers until grass has grown.

B. Temporary Erosion Control

1. Provide temporary seeding and mulching as delineated in the SWP3, as directed, as specified in the general NPDES permit, and for all denuded areas that are to remain dormant for more than 21 days.

2. Apply temporary erosion control within 7 days after final or temporary grade has been reached that will remain dormant for more than 21 days.

3. For areas within 50 feet of a stream, apply temporary erosion control within 2 days after the most recent disturbance of an area that will remain dormant for more than 21 days.

4. Install temporary erosion control measures including seeding and mulching immediately if seasonal limitations make permanent control measures unrealistic.

5. Temporary seed shall be of the type specified in ODNR's Rainwater and Land Development manual for the time of year that it is applied. Temporary seeding shall also include application of 12-12-12 fertilizer at the rate of 6 pounds per 1,000 square feet and mulching in accordance with ODNR's Rainwater and Land Development manual.

3.4 SEDIMENT BARRIERS

A. **Filter Barriers (FB)**. Construct the FBs using synthetic filter fabric. They are designed for sediment removal and erosion control of low or moderate channelized flows not exceeding 1 cubic foot per second (cfs).

1. The height of an FB shall be between 15 inches and 18 inches.

2. Purchase filter fabric in a continuous roll and avoid the use of joints by cutting to the length of the barrier.

3. Space the stakes a maximum of 3 feet apart at the barrier location and drive them securely into the ground (minimum of 8 inches).

4. Excavate a trench approximately 4 inches wide and 4 inches deep along the line of stakes and upslope from the barrier.

5. Staple the filter material to the wooden stakes, and extend 8 inches of the fabric into the trench. Use heavy-duty wire staples at least 1/2 inch long. Do not staple filter material to trees.

6. Backfill the trench and compact the soil over the filter material.

7. Install straw bales on the downstream side of all filter barriers. Install bales in a single row and securely anchor them with a minimum of two stakes per bale.

8. If an FB is to be constructed across a ditch line or swale, the barrier shall be of sufficient length to eliminate end flow, and the plan configuration shall resemble an arc or horseshoe with the ends oriented upslope.

9. Remove FB when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

B. **Silt Fence (SF)**. SF is designed for situations in which only sheet or overland flows are expected, and the following drainage area limits are applied.

Silt Fence Maximum Drainage Area (Based on Slope of Drainage Area)	
Slope	Maximum Drainage Area (Acres) to 100 Linear Feet of Silt Fence
0-2% (<50:1)	0.5
2%-20%	0.25
>20%	0.125

1. SF details are included on the plans or within ODNR's Rainwater and Land Development manual.
2. Locate the silt fence at the flattest area available and follow a level contour of the land so that flows are dissipated into uniform sheet flow.
3. The height of an SF shall not exceed 36 inches (higher fences may impound volumes of water sufficient to cause failure of the structure).
4. Purchase the filter fabric in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, splice filter cloth together only at a support post, with a minimum 6-inch overlap, and securely seal.
5. Drive posts securely into the ground (minimum of 12 inches).
6. Excavate a trench approximately 4 inches wide and 4 inches deep along the line of posts and upslope from the barrier.
7. Staple or wire the filter fabric to the fence, and extend 8 inches of the fabric into the trench. The fabric shall not extend more than 36 inches above the original ground surface. Do not staple filter fabric to trees.
8. Backfill the trench and compact the soil over the filter fabric.
9. Remove SF when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

C. Maintenance

1. Inspect SF and FB a minimum of every 7 days and immediately after each rainfall or at least daily during prolonged rainfall. Make any required repairs immediately.
2. Should the fabric on an SF or FB decompose or become ineffective prior to the end of the expected useable life and the barrier is still necessary, replace the fabric promptly.
3. Remove sediment deposits after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.

4. Dress any sediment deposits remaining in place after the SF or FB is no longer required to conform with the existing grade, and prepare and seed them.

3.5 MATTING

A. **General**. Matting details are included in ODNR's Rainwater and Land Development manual. Provide matting:

1. On all final slopes 3:1 or greater.
2. Along the bottom of all drainage ditches until permanent seeding has grown and is established.
3. In areas where establishing vegetation is difficult.
4. Where mulch is difficult to hold in place due to wind or water.
5. Where water velocities exceed 3.5 feet per second.

B. **Securing**. Secure matting in accordance with the manufacturer's instructions or with No. 11 gauge, or heavier, sod staples that are a minimum of 6 inches in length.

C. Erosion Stops

1. Erosion stops are narrow trenches (6 to 12 inches deep) across the full channel section to prevent undermining and gullies from forming below the matting.
2. Provide them at a maximum spacing of 50 feet apart (more frequently if recommended by the matting supplier) in areas of high erosion potential and at the leading edge of a matting roll.
3. High erosion potential is in rocky areas that prevent soil-to-matting contact, erosive soils, and steep slopes.
4. Place the leading edge or piece of matting (for intermediate stops) within the narrow trench and secure it in place before backfilling the trench.

3.6 STORM DRAIN INLET PROTECTION (IP)

A. General

1. Provide temporary sediment control around all storm inlets until the tributary drainage area is permanently stabilized.
2. This shall consist of an inlet sediment filter of silt fencing as specified and detailed herein.
3. Utilize storm drain IP at all storm drain inlets in addition to matting and sediment barriers previously discussed.

B. **Yard, Drainage Ditch, or Parking Lot Inlet Protection**. Details are included in ODNR's Rainwater and Land Development manual.

1. Filter Fabric.
    a. Excavate earth to a minimum depth of 18 inches around inlet.
    b. Construct wood framing with a minimum burial depth of 8 inches at each corner of the inlet.

c. Filter fabric shall include a wire mesh backing for structural support.

d. Place backfill in 6-inch compacted lifts.

e. Install a compacted earth check dam in the ditch line below the inlet if runoff bypassing the inlet will not flow to a sediment pond.

2. Drop Inlet Sediment Protection. Inlets may utilize an excavated drop inlet consisting of a 1- to 2-foot-deep excavation around the inlet to serve as a sediment trap.

a. Expanded trap volume shall be in accordance with the requirements for sediment traps contained in this specification.

b. Install 1-inch-diameter weep holes in the side of the inlet near the bottom of the excavated areas. Provide a gravel filter around weep holes. Weep holes shall be grouted before filling excavated area.

c. Remove accumulated sediment when it has reached 40 percent of the trap depth.

C. **Curb Inlet Protection**. Details are included in ODNR's Rainwater and Land Development manual.

1. Frame. Construct a wooden frame that is anchored to the soil located behind the curb.

2. Screen. Form a geotextile fabric screen with wire mesh backing to the concrete gutter and against the face of the curb. Extend the screen 2 feet beyond the inlet throat on either end and fasten to the frame.

3. Stone. Place 2-inch stone over the screen to prevent water from entering the inlet under or around the geotextile fabric.

3.7 SEDIMENT TRAPS

A. Provide temporary sediment traps for sediment control for drainage areas totaling less than 5 acres when SF would be inadequate or inappropriate. Traps have a simple outlet structure stabilized with geotextile and riprap. Sediment trap details are included in ODNR's Rainwater and Land Development manual.

B. Design

1. Volume. Sediment trap shall include a minimum water volume of 67 cubic yards (cy) per acre of contributing drainage area plus sediment storage of 1,000 cubic feet (cf) per disturbed area of contributing area. Provide a larger water volume if required by the general NPDES permit.

2. Side Slopes. Maximum side slopes of 3:1.

3. Depth. 1.5 feet above outlet crest. Utilize a maximum height of 5 feet.

4. Dimensions. Maximize sediment removal efficiencies by maximizing surface areas and providing a minimum length-to-width ratio of 2:1.

5. Outlet. Provide either a piped discharge with outlet riser or an overflow spillway that is properly sized to ensure safe release of all storm water. Locate outlets, as much as practical, on the opposite side of the storm

water entrance in order to avoid short-circuiting and maximize the sediment removal efficiency.

6. Channel Protection. Protect outlet spillways from erosion through use of a filter fabric and rock channel protection (ODOT Type C or D).

C. **Maintenance**. Maintain sediment level below the minimum water volume.

3.8 SEDIMENT BASINS AND DAMS

A. Sediment basins are sediment traps required for drainage areas greater than 5 acres. Sediment basins are larger than sediment traps and include dams that are regulated by the ODNR, Division of Water. Sediment basin details are included in ODNR's Rainwater and Land Development manual.

B. Design

1. Volume. Minimum water volume of 67 cy per acre of contributing area plus sediment storage volume of 1,000 cf per disturbed acre of contributing area.

2. Depth. Optimum depth of 3 feet, maximum of 5 feet.

3. Dimensions. Minimum length-to-width ratio of 2:1.

4. Side Slopes. Maximum of 3:1.

5. Outlet. Include both a primary and emergency spillway. Size the primary to pass a 10-year, 24-hour storm with the maximum water level at the crest of the emergency spillway. Emergency spillway shall pass the 100-year, 24-hour storm.

6. Reference. See ODNR's Rainwater and Land Development Manual for additional sizing and design criteria.

C. **Permitting**. If the sediment basin is such that it qualifies as a dam regulated by ODNR, obtain the appropriate permits and approvals from ODNR prior to construction of the dam. Submit a copy of this permit/approval prior to commencement of construction.

D. **Maintenance**. Remove deposited sediment when 40 percent of the initial volume has been filled with silt.

3.9 ROCK CHANNEL PROTECTION

A. Provide rock channel protection at all storm outlets in accordance with ODOT Item 601.

3.10 TOP SOIL STOCKPILE

A. Provide temporary drainage diversion of runoff around the topsoil stockpile to control soil erosion. Provide silt fencing around stockpiles or cover stockpiles with tarps to prevent erosion for sediment control.

3.11 STREAM BANK WORK

A. Special attention must be given at stream bank work locations to prevent erosion into the stream. Provide SF or drainage ditches with sediment traps at such locations. Hold to a minimum the entire disturbed area around any stream bank work. Designate trees and vegetation to be removed; clearly mark and protect those to be preserved. Following construction, promptly vegetate all sites other than roadways.

3.12 STREAM CROSSINGS AND WORK WITHIN THE STREAM

A. General

1. Avoid stream crossings and work within a stream when possible.

2. However, for certain work it may be necessary to work within the stream channel or develop a temporary crossing.

3. Keep to a minimum the time that is required to perform this work or that any temporary crossing is maintained, and remove any crossing as soon as possible.

4. Construct the culverts, bridges, and other structures of nonerodible material and size appropriately.

5. Be responsible for obtaining all local, state, or U.S. Army of Corps of Engineers (USACE) approvals or permits necessary prior to commencement of constructing the stream-crossing measure.

6. To reduce erosion and siltation impacts, perform construction in water courses only during periods of dry weather and low-flow conditions.

3.13 CONSTRUCTION ENTRANCES/EXITS

A. Install a stabilized pad of aggregate over geotextile fabric at all locations where construction vehicles leave construction areas onto surfaces where runoff is not checked by sediment controls, and at all points of egress to paved roads.

B. Design

1. Bedding. Provide a geotextile fabric bedding at the base of the construction entrance.

2. Stone. Place 2-inch stone in a layer 6 inches thick over the fabric bedding.

3. Dimensions. Entrance/exit pad shall be a minimum of 10 feet wide by 50 feet long.

C. **Maintenance**. Apply additional stone as necessary to replenish the entrance/exit. Remove sediment from paved roads immediately through sweeping, scraping, or other appropriate measure.

3.14 DEWATERING

A. General

1. Give special attention to dewatering activities to minimize release of silt-laden water into the stream.

2. The discharges shall be free of sediment and released into only storm sewers, stream channels, or other stabilized drainage sources and not onto exposed soils or any other site where flows could cause further erosion.

3.15 ADDITIONAL MEASURES

A. Select the sediment and erosion control measures utilized for a site based on the proposed construction activities, existing and proposed contours, site drainage system, and other site requirements or restrictions. Additional or alternative erosion and sediment control measures may be utilized with approval. Such measures include those specified in ODNR's Rainwater and Land Development manual.

END OF SECTION

Notice of Intent (NOI) For Coverage Under Ohio Environmental Protection Agency General Permit

(Read accompanying instructions carefully before completing this form)

Submission of this NOI constitutes notice that the party identified in Section I of this form intends to be authorized to discharge into state surface waters under Ohio EPA's NPDES general permit program. Becoming a permittee obligates a discharger to comply with the terms and conditions of the permit. Complete all required information as indicated by the instructions. Forms transmitted by fax will not be accepted. A check for the proper amount must accompany this form and be made payable to "Treasurer, State of Ohio." (See the fee table in Attachment D of the NOI instructions for the appropriate processing fee)

I. Applicant Information/Mailing Address

Company (Applicant) Name: _____

Mailing (Applicant) Address: _____

City: _____ State: _____ Zip Code: _____

Contact Person: _____ Phone: _____ Fax: _____

Contact E-Mail Address: _____

II. Facility/Site Location Information

Facility Name: _____

Facility Address/Location: _____

City: _____ State: _____ Zip Code: _____

County(ies): _____ Township(s): _____

Facility Contact Person: _____ Phone: _____ Fax: _____

Facility Contact E-Mail Address: _____

Quarter: _____ Section(s): _____ Range: _____

Receiving Stream or MS4: _____

If aware of a state nature preserve within 1,000 feet of the facility/site, check here:

Enter river code here, if discharge is to a river designated scenic, wild, or recreational, or to a tributary within 1,000 feet (see instructions): _____

General Permit Number: _____ Initial Coverage: Renewal Coverage:

Type of Activity: _____

SIC Code(s): - _____ - _____ - _____ - _____

Existing NPDES Permit Number: _____

ODNR Coal Mining Application Number: _____

Outfall	Design Flow (MGD)	Latitude	Longitude

For Ohio EPA Use Only

Check ID (OFA): _____

Person: _____

Place: _____

DOC #: _____

ORG #: _____

Rev. ID #: _____

Other DSW Permits Required: _____

Proposed Project Start Date (MO DY YR): _____ Estimated Completion Date: (MO DY YR): _____

Total Land Disturbance (Acres): _____ MS4 Drainage Area (Square Miles): _____

Payment Information: Check # _____ Check Amount: _____ Date of Check: _____

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Applicant Name: _____ Title: _____

Applicant Signature: _____ Date: _____

EPA 4494 (Rev. 12/09)

Click to clear all entered information

Notice of Termination (NOT) of Coverage Under Ohio Environmental Protection Agency General Permit

(Read accompanying instructions carefully before completing this form)

Submission of this NOT constitutes notice that the party identified in Section II of this form is no longer authorized to discharge into state waters under the NPDES general permit program. NOTE: All necessary information must be provided on this form. Do not use correction fluid on this form. Forms transmitted by fax will not be accepted. There is no fee associated with submitting this form.

I. Permit Information:

NPDES general permit number: OH _____ Facility General Permit Number: _____

II. Owner/Applicant Information/Mailing Address:

Company Name: _____

Contact Person: _____ Phone: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

II. Facility/Site Location Information:

Facility Name: _____

Facility Contact Person: _____ Phone: _____

Facility Address/Location: _____

City: _____ State: _____ Zip Code: _____

County: _____ Township: _____ Section: _____

IV. Reason for Termination:

_____ Transfer of Ownership _____ Cease to Discharge _____ Facility Closed _____ Project Completed

_____ Obtained Individual Permit

Standard Certification:

I certify under penalty of law that all discharges authorized by the NPDES general permit have been eliminated or that I am no longer the operator of the facility. I understand that by submitting this NOT, I am no longer authorized to discharge under this general permit and that discharging pollutants to waters of the state without a NPDES permit is unlawful under ORC 6111.

Name (typed): _____

Signature: _____ Date: _____

Industrial Storm Water and Coal Mining Activity Certification Only:

I certify under penalty of law that all discharges associated with the identified facility that are authorized by the above referenced NPDES general permit have been eliminated, that I am no longer the operator of the facility, or in the case of a coal mine that the SMCRA bond has been released by ODNR-Division of Reclamation. I understand that, by submitting this NOT, I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that all discharging pollutants in storm water associated with industrial activity to waters of the state is unlawful under ORC 6111 where the discharge is not authorized by a NPDES permit.

Name (typed): _____

Signature: _____ Date: _____

Storm Water Construction Activity Certification Only:

I certify under penalty of law that all elements of the storm water pollution prevention plan have been completed, the disturbed soil at the identified facility have been finally stabilized and temporary erosion and sediment control measures have been removed or will be removed at an appropriate time, or that all storm water discharges associated with construction activity from the identified facility that are authorized by the above referenced NPDES general permit have otherwise been eliminated. I understand that, by submitting this NOT, I am no longer authorized to discharge storm water associated with construction activity by the general permit, and that discharging pollutants in storm water associated with construction activity to waters of the state is unlawful under ORC 6111 where the discharge is not authorized by a NPDES permit.

Name (typed): _____

Signature: _____ ***Date:*** _____

EPA 4493 (Rev. 9/06)

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SECTION 01 58 13

PROJECT SIGN

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to provide a project sign in accordance with the drawings and specifications.

B. Work shall include removal and replacement of all signs in areas where work is required per Contract Documents.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS

A. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. General

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

C. Submittal Package No. 1 – Project Sign Shop Drawing

1. Provide a shop drawing, for approval, outlining the construction details of the sign and lettering that will be placed on the sign.

1.5 **JOB CONDITIONS**. Erect project sign within 2 weeks of the beginning of construction. Maintain signage until final completion of the project unless otherwise directed.

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 MATERIALS

A. **Sign**. Construct the sign of the following materials:

1. Sign face shall be 3/4-inch exterior plywood.

2. The posts shall be 4" x 4" treated lumber.

3. The paint shall be exterior acrylic. The back and front of the sign shall have three coats of white paint on which lettering shall be painted in black.

a. The principal sign (4' x 8') shall have the name of the project; the Owner of the project; Project Cost; Engineer; and General Contractor.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Site Verification**. Verify that no existing utilities or proposed improvements interfere with the designated sign location.

B. **Local Traffic**. Coordinate location and height of the sign with the agency responsible for highway or street safety if the sign is in an area where an obstruction to the line of sight is possible.

3.2 PREPARATION

A. **Orientation**. Orientation will be such that the sign is easily viewed by the traffic arriving to the site.

B. **Location**. Place the sign at the location designated.

3.3 INSTALLATION

A. Set the two posts at least 3 feet into the ground and fill the hole with concrete or brace with 2" x 4" material.

3.4 FIELD QUALITY CONTROL

A. Routinely trim grass and weeds from around the sign and within the line of sight of those reading the sign.

3.5 DEMOLITION

A. **Remove the sign**, sign posts, and any concrete used to secure the sign posts from the site.

B. **Fill the post holes** and seed over them.

END OF SECTION

SECTION 01 60 00

MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Transport and handle materials and equipment in accordance with the manufacturer's recommendations and requirements of Contract Documents. Make all arrangements for transportation, delivery, storage, and handling of equipment and materials required for prosecution and completion of the work.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS (Not used)

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Deliver shipments of materials and equipment to the site only during regular working hours.

2. Shipments shall be addressed and consigned to the proper party giving name of Contract, street number, and city.

3. Shipments shall not be delivered to the Owner or Owner's Representative, except as otherwise directed.

4. Transportation shall be in accordance with Part 3 of this section.

B. Storage and Handling

1. Store, handle, and protect materials in accordance with the manufacturer's recommendations and the requirements of Part 3 of this section.

2. Maintain equipment in an undeteriorated and fully serviceable condition and as specified in Part 3 of this section.

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 TRANSPORTATION

A. **General**. Arrange deliveries of products in accordance with the construction schedule and in ample time to facilitate inspection prior to installation.

B. Coordination

1. Coordinate deliveries to avoid conflict with work and conditions at site and to accommodate the following:

a. Work of other contractors.

b. Limitations of storage space.

c. Availability of equipment and personnel for handling products.

d. Owner's use of premises.

2. Do not have products delivered to project site until related shop drawings have been approved.

3. Do not have products delivered to site until required storage facilities have been provided.

4. Have products delivered to site in manufacturer's original, unopened, labeled containers. Keep Engineer/Architect informed of delivery of all equipment to be incorporated in the work.

C. **Inspection**. Immediately upon delivery, inspect shipment to ensure that:

1. Product complies with requirements of Contract Documents and reviewed submittals.

2. Quantities are correct.

3. Containers and packages are intact and labels are legible.

4. Products are properly protected and undamaged.

5. Damaged products are rejected and removed from the site.

3.2 HANDLING

A. Methods

1. Provide equipment and personnel necessary to handle products without soiling or damaging products or packaging.

2. Lift heavy components only at designated lifting points.

3. Handle materials and equipment at all times in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them.

4. Do not drop, roll, or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

5. Keep interiors completely free of dirt and foreign matter.

3.3 STORAGE AND PROTECTION

A. General

1. Make all arrangements and provisions necessary for the storage of materials and equipment.

2. Place all excavated materials, construction equipment, and materials and equipment to be incorporated into the work so as not to damage anything.

3. Keep materials and equipment neatly and compactly stored in locations that will cause a minimum of inconvenience to other contractors, public travel, adjoining owners, tenants, and occupants.

4. Arrange storage in a manner to provide easy access for inspection.

B. Storage Areas

1. Areas available on the construction site for storage of material and equipment shall be as shown or otherwise approved.

2. Store materials and equipment which are to become the property of the Owner in a way to facilitate their inspection and ensure preservation of the quality and fitness of the work, including proper protection against damage by freezing and moisture.

3. Lawns or other private property shall not be used for storage purposes without written permission of the Owner in control of such premises.

4. Restore all storage areas to their original condition.

C. Storage Methods

1. Do not open manufacturer's containers until the time of installation unless recommended by the manufacturer or otherwise specified.

2. Do not store products in the structures being constructed unless approved in writing.

3. The following types of materials may be stored out-of-doors and on wood blocking so there is no contact with the ground.

   a. Masonry units.

   b. Reinforcing steel.

   c. Structural steel.

   d. Piping.

   e. Precast concrete items.

   f. Castings.

   g. Handrailing.

4. The following types of materials may be stored out-of-doors if covered with material impervious to water and sunlight. Store materials on wood blocking and tie down covers with rope and slope to prevent accumulation of water on covers.

   a. Construction lumber.

   b. Wood for formwork.

   c. Fiberglass and plastic materials which are not ultraviolet (UV) protected.

5. Store all products not listed above in buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.

6. Provide heated storage space for materials that would be damaged by freezing.

7. Protect mechanical and electrical equipment from contamination by dust, dirt, and moisture.

8. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

D. Inspection

1. Regularly inspect stored products to ensure that:

a. State of storage facilities is adequate to provide required conditions.

b. Required environmental conditions are maintained on continuous basis.

c. Products exposed to elements are not adversely affected.

2. Be fully responsible for loss or damage to stored materials and equipment.

3.4 MAINTENANCE

A. **Maintenance Log**. Prepare a maintenance log for all equipment.

1. This log shall include a list of required maintenance services and inspections, as provided by the manufacturer.

2. The log shall include checklists for the periodic services and inspections required.

3. Initial and date the checklist upon completion of the individual servicing or inspection.

4. Locate the maintenance log in the field office and have it available for review until it is submitted for record purposes upon completion of the work and the start of the warranty period.

B. Preparation

1. Before removing an item from storage, review the installation location. Protection and services at the installed location must meet the equipment storage requirements.

2. Before moving equipment to the installed location, have materials available for temporary shelter or services required to establish the proper storage environment.

C. Performance of Maintenance

1. Perform all storage and preventive maintenance and inspections required by the manufacturer at the specified intervals from the time of delivery until completion of the work.

2. When notified by the Owner or Owner's Representative of a maintenance deficiency, perform corrective maintenance. Corrective maintenance will be performed per the manufacturer.

3. Reestablish storage maintenance in the event an item or equipment is removed from service.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to construct the project in accordance with these plans and specifications.

B. **This section specifies administrative** and procedural requirements for cutting and patching.

C. **Refer to other sections** for specific requirements and limitations applicable to cutting and patching individual parts of the work.

1. Requirements of this section apply to mechanical and electrical installations. Refer to Divisions 22, 23, and 26 for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

D. **Demolition of selected portions** of the building for alterations is included in section "Selective Demolition."

1.3 QUALITY ASSURANCE

A. **Requirements for Structural Work**. Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load deflection ratio.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:

a. Foundation construction.

b. Bearing and retaining walls.

c. Structural concrete.

d. Structural steel.

e. Lintels.

f. Timber and primary wood framing.

g. Structural decking.

h. Stair systems.

i. Miscellaneous structural metals.

j. Exterior curtain wall construction.

k. Equipment supports.

l. Piping, ductwork, vessels and equipment.

m. Structural systems of special construction in Division 13.

B. **Operational and Safety Limitations**. Do not cut and patch operating elements or safety-related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance or decreased operational life or safety.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety-related systems:

a. Shoring, bracing, and sheeting.

b. Primary operational systems and equipment.

c. Air or smoke barriers.

d. Water, moisture, or vapor barriers.

e. Membranes and flashings.

f. Fire protection systems.

g. Noise and vibration control elements and systems.

h. Control systems.

i. Communication systems.

j. Conveying systems.

k. Electrical wiring systems.

l. Special construction specified by Division 13 sections.

C. **Visual Requirements**. Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer/Architect's opinion, reduce the building's aesthetic qualities or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.

1. If possible retain the original installer or fabricator to cut and patch the following categories of exposed work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm.

a. Processed concrete finishes.

b. Stonework and stone masonry.

c. Ornamental metal.

d. Matched veneer woodwork.

e. Preformed metal panels.

f. Window wall system.

g. Stucco and ornamental plaster.

h. Acoustical ceilings.

i. Terrazzo.

j. Finished wood flooring.

k. Fluid applied flooring.

l. Carpeting.

m. Aggregate wall coating.

n. Wall covering.

o. Swimming pool finishes.

p. Heating, ventilating, and air conditioning (HVAC) enclosures, cabinets, or covers.

1.4 SUBMITTALS

A. **General**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Cutting and Patching Proposal

1. Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal.

a. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.

b. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.

c. List products to be used and firms or entities that will perform work.

d. Indicate dates when cutting and patching are to be performed.

e. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

2. Approval to proceed with cutting and patching does not waive the right to later require complete removal and replacement of a part of the work found to be unsatisfactory.

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed. Take corrective action before proceeding if unsafe or unsatisfactory conditions are encountered.

3.2 PREPARATION

A. **Temporary Support**. Provide temporary support of work to be cut.

B. **Protection**. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the project that might be exposed during cutting and patching operations.

C. **Avoid interference** with use of adjoining areas or interruption of free passage to adjoining areas.

D. **Take all precautions necessary** to avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General

1. Employ skilled workmen to perform cutting and patching.
2. Proceed with cutting and patching at the earliest feasible time and complete without delay.
3. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. **Cutting**. Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
4. Comply with requirements of applicable sections of Division 31 where cutting and patching requires excavating and backfilling.
5. Bypass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated, or abandoned. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after bypassing and cutting.

C. **Patching**. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance.
4. Remove existing floor and wall coverings and replace with new materials if necessary to achieve uniform color and appearance.
5. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat.
6. Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching are performed or used as access. Remove completely paint, mortar, oils, putty, and items of similar nature. Thoroughly clean piping, conduit, and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

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SECTION 01 74 23

CLEANING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Throughout the construction period, maintain all areas of existing buildings and site constructed or affected by the work of the Contract in a standard of cleanliness as described in this section. This shall include progress cleaning, as condition precedent to Substantial Completion, upon completion of the Work, and as required by the General Conditions, this specification, and elsewhere in the Contract Documents.

1. All floors, base, ceilings, and walls shall be cleaned as required by product supplier prior to completing the work detailed on the Room Finish Schedule provided on Sheet A-17. If the supplier does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and safety of the personnel and will not damage exposed surfaces.

B. **Related Work Described Elsewhere**. In addition to standards described in this section, comply with all requirements for cleaning up as described in various other sections of these specifications.

1.3 QUALITY ASSURANCE

A. **Inspection**. Conduct daily inspections, and more often if necessary, to verify that requirements of cleanliness are being met.

B. **Codes and Standards**. In addition to the standards described in this section, comply with all pertinent requirements of governmental agencies having jurisdiction and comply with Occupational Safety and Health Administration (OSHA) Housekeeping Standards, Subpart C, Section 1926.25.

1.4 SUBMITTALS (Not used)

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Provide all required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

2.2 COMPATIBILITY

A. Use only the cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material.

PART 3 EXECUTION

3.1 EXAMINATION

A. General

1. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic (vehicle and foot), and providing the required protection of materials.
2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of the work.
3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.
4. Comply with OSHA Section 1926-252 of Subpart H of Part 1926, Disposal of Waste Materials.
5. Provide adequate storage for all items awaiting removal from job site, observing all requirements for fire protection and protection of the environment.
6. Do not bury waste materials within the project site.
7. Comply with NFPA 241 for removing combustible waste materials and debris.
8. Do not hold non-combustible materials at the Site more than three (3) days if the ambient air temperature is expected to rise above 80 DEGF. When ambient air temperature is less than 80 DEGF, dispose of non-combustible materials within seven (7) days of their generation.
9. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.
10. Clean areas where the Work is in progress to maintain an extent of cleanliness necessary for proper execution of the Work and safety of personnel.
11. Remove waste material and rubbish from excavations before backfill and do not burn or bury waste materials at the site.
12. Clean completed construction as frequently as necessary throughout the construction period. This shall include both existing and new equipment, walls, ceilings, and floors.

B. Site

1. Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material.
2. Weekly, and more often if necessary, inspect all arrangements of materials stored on the site; restack, tidy, or otherwise service all arrangements to meet the requirements herein.
3. Maintain the site in a neat and orderly condition at all times and comply with OSHA Housekeeping Standards, Subpart C, Section 1926.25.
4. Keep outdoor dust generating areas wetted down or otherwise control dust emissions.

C. Structures

1. Weekly, and more often if necessary, inspect the structures, pick up all scrap, debris, and waste material.

2. Weekly, and more often if necessary, sweep all interior spaces clean. Interpret "Clean" (for the purpose of this subparagraph) as meaning free from dust and other material capable of being removed by use of reasonable effort and hand-held broom, except that vacuum cleaning shall also be employed if dust accumulates on surfaces above floor.

3. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using all equipment and materials required to achieve the required cleanliness.

4. Following the installation of finish floor materials, clean finish floor daily (and more often if necessary) while work is being performed in the space. Interpret "clean" (for the purpose of this subparagraph) as meaning free from all foreign material which may be damaging to the finish floor material.

5. Remove waste material and debris from concealed spaces and vaults before enclosing the space.

3.2 FINAL CLEANING

A. **Definition**. Except as otherwise specifically provided, interpret "clean" (for the purpose of this paragraph) as meaning the level of cleanliness generally provided by skilled cleaners using commercial-quality building maintenance materials.

B. **General**. Prior to completion of the work, remove from the job site all tools, surplus and testing materials, equipment, scrap, debris, temporary protection, and waste. Conduct final cleaning as described in herein.

1. Clean installed surfaces (floors, walls, ceiling, equipment, piping, etc) according to written instructions of the manufacturer or fabricator of installed materials and equipment, using only cleaning agents and methods specifically recommended by material or equipment supplier. This is applicable to all existing and proposed surfaces.

a. If the supplier does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and safety of the personnel and will not damage exposed surfaces.

C. **Site**. Unless otherwise directed, broom-clean all paved areas on the site and all public paved areas directly adjacent to the site. Completely remove all resultant debris.

D. Structures

1. Exterior.

a. Visually inspect all exterior surfaces and remove all traces of soil, waste material, smudges, and other foreign matter.

b. Remove all traces of splashed materials from adjacent surfaces.

c. If necessary to achieve a uniform degree of exterior cleanliness, hose and brush down the exterior of the structure.

d. In the event of stubborn stains not removable with water, lightly sandblast to remove the stain.

2. Interior.

a. Visually inspect all interior surfaces and remove all traces of soil, waste material, smudges, and other foreign matter.

b. Remove all traces of splashed materials from adjacent surfaces.

c. Remove all paint droppings, spots, stains, and dirt from finished surfaces.

d. Sweep, vacuum, and hand-dust all areas, including concealed surfaces and overhead spaces, to remove all dust.

3. Glass. Clean all glass inside and outside.

4. Polished surfaces. To all surfaces requiring the routine application of buffed polish, apply the polish recommended by the manufacturer of the material being polished.

END OF SECTION

SECTION 01 75 00

FACILITY START-UP

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, tools, equipment, and materials necessary to complete the general requirements for facility start-up and operation of subsystems, systems, and equipment. Start up, test, and operate the completed work including systems and equipment until substantial completion is achieved and the completed work including systems and equipment is accepted by the Owner. Contractor shall cooperate and coordinate with the Owner or Owner's Representative in the operation, maintenance, and adjustment of the work.

1.3 QUALITY ASSURANCE (Not Used)

1.4 SUBMITTALS

A. **Qualifications of Manufacturer's Representative**. Resumes of manufacturer's representatives stating qualifications and experience of individuals proposed for performing facility start-up shall be submitted to the Engineer/Architect for review at least 2 weeks prior to the scheduled date for facility start-up. The Owner and/or Engineer/Architect shall have the right to reject the use of an individual for facility start-up.

B. Manufacturer's Representative Reports

1. The manufacturer's representative shall prepare a daily report on each site visit for each system or item of equipment inspected, adjusted, started up, or worked on. If a manufacturer's representative visits the site for equipment specified in several specification sections, a separate report shall be filed for each specification section.

2. The report shall state the purpose of the visit, the representative's observations and conclusions, and recommendations for further visits or action. The manufacturer's representative shall maintain a log of the settings of all adjustable components. Initial settings shall be recorded and submitted on the first visit. During subsequent visits, the manufacturer's representative shall add the current or adjusted setting to the log.

3. The reports shall be submitted within 48 hours of the visit.

1.5 JOB CONDITIONS

A. **Facility Start-Up**. The series of activities necessary to bring a component, system, or unit process from installation to operational demonstration. Facility start-up includes but is not limited to field testing, dry testing, wet testing,

performance testing, manufacturer's checkout, and start-up, ready for operational demonstrations. Requirements for testing, adjusting, and balancing are provided in Section 01 75 16. Requirements for operational demonstrations are provided in Section 01 79 00.

B. **Start-Up**. Narrowly defined as placing a component, system, or unit process on-line.

C. **Operational Demonstration**. An activity performed by the Contractor wherein the Contractor operates and maintains a fully functional component, system, or unit process for a period of time after facility start-up and stable operation have been achieved in conformance with Section 01 79 00.

D. **Field Testing**. Testing performed on-site by the Contractor to satisfy requirements of the manufacturer and Contract Documents and in conformance with Section 01 75 16.

E. **Manufacturer's Checkout**. Field inspection, testing, adjustments, and sign-off by the manufacturer's representative, indicating that the component, system, or unit process meets the manufacturer's requirements.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITIONS

A. **Prior Inspections**. The Contractor shall inspect systems and equipment prior to each start-up and verify their readiness for start-up. Conditions hazardous to equipment or personnel shall be corrected by the Contractor prior to start-up of equipment.

1. Start-up operations shall not proceed using temporary power or temporary instrumentation and control wiring unless approved by the Engineer/Architect. All electrical and control connections shall be permanent and complete, and all such electrical components and equipment fully functional.

2. Use of repair parts during start-up operations shall not be permitted, except in such situations where the actual on-site verification of such repair parts' operability is specified.

3.2 PREPARATION

A. **Test Equipment**. Prior to start-up of equipment or systems, all necessary test equipment shall be in place and operable.

B. **Manufacturer at Site**. Manufacturer's representative(s) shall be present for the initial start-up of systems or equipment.

C. **Permission and Notification**. The Contractor shall request permission to start up equipment, including electrical gear, and notify the Engineer/Architect of the start-up.

1. The start-up request shall be submitted a minimum of 72 hours before the scheduled start-up. Requests shall be made during normal working hours.

2. Approval of the request is based solely on impact on plant operations. Approval does not relieve the Contractor of any responsibility for plant and personnel safety.

D. **Installation Checks**. Normal installation checks, such as for rotation, are not considered start-ups and do not require start-up notification. All electrical apparatus which is energized shall be clearly marked.

3.3 CONDUCT OF START-UP

A. Start-Up

1. All initial start-ups of equipment or systems so designated in the specifications shall be performed under the technical direction of the manufacturer's representative.

2. Any lack of readiness of associated systems or failure of a system or equipment previously started prior to the date of final acceptance of the project shall require additional start-up service by the manufacturer to be performed.

3. The Contractor shall repair, replace, or modify any equipment or system which fails to perform as specified in the individual sections of Divisions 2 through 46.

B. **Available Knowledgeable Contractor Personnel**. When Owner personnel are operating systems or equipment, the Contractor shall make available, at all times, persons knowledgeable about the systems or equipment to direct the Owner personnel in its operation.

C. **Adjustments and Corrections**. The Contractor shall make all adjustments and corrections necessary to achieve normal, stable operation of systems.

D. **Failures and Corrections**. Any failures of equipment or systems operated under the direction of the Contractor shall be considered deficiencies and shall be corrected.

E. **Plant Operations and Processes**. During the facility start-up and at other times, the work will be on-line and an integral part of the plant operations and process. The Owner maintains control of treatment plant operations and processes at all times. Therefore:

1. The Contractor shall not commence, resume, terminate, or suspend the operations without the permission of the Owner and only in a sequence and manner suitable to the Owner.

2. The operation of the work shall be in strict accordance with the operational orders of the Owner.

3. The Contractor shall immediately, on a 24-hour-per-day, 7-day-per-week basis, adjust or repair any malfunction in the work which in the opinion of the Owner jeopardizes or may jeopardize the proper operation of the plant.

4. The Contractor shall not start up, shut down, adjust, or otherwise alter the operation of any component, system, or unit process without the permission of the Owner except in the case of an emergency.

END OF SECTION

SECTION 01 75 16

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. This section includes general requirements for the conduct of testing, adjusting, and balancing. Testing, adjusting, and balancing shall be performed in accordance with recognized industry standards and as specified in individual sections of Divisions 2 through 46 of the specifications.

1.3 QUALITY ASSURANCE (Not Used)

1.4 SUBMITTALS

A. **General**. Test reports shall be submitted within 48 hours of the completion, suspension, or termination of the test unless otherwise approved. Test reports shall fully describe the test and results as well as settings of all adjustable components.

1.5 JOB CONDITIONS

A. **General**. The requirements of this section are in addition to those specified by regulatory agencies. Except as specifically prohibited or modified by regulatory requirements, comply fully with all requirements of this section.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. **General**. The Contractor shall supply all materials and equipment used in testing, adjusting, and balancing.

B. **Materials and Equipment**. Materials and equipment used shall be of good quality and suitable for the intended service. The use of miscellaneous items found at the job site is not acceptable.

C. **Range or Capacity**. Select range or capacity of test equipment to provide meaningful test results. Select pressure or differential pressure gauges so that test pressure is 50 percent to 75 percent of maximum gauge reading.

2.2 FABRICATION

A. **Temporary Equipment**. The Contractor shall fabricate, as necessary, any temporary equipment used in testing.

2.3 SOURCE QUALITY CONTROL

A. **Instrument Calibrations**. All instruments shall be calibrated to recognized standards by the instrument manufacturer or a qualified independent calibration

laboratory. Retain instrument calibration data at the Contractor's site office for Owner or Owner's Representative's review.

2.4 TESTING DEFINITIONS

A. **Dry Testing**. Dry testing is performed by the Contractor without introducing either process material or other test material into the component, system, or unit process.

B. **Wet Testing**. Wet testing is performed by the Contractor utilizing test material in the component, system, or unit process. Process tankage shall be filled with test material to operating level.

C. **Performance Testing**. Performance testing is performed by the Contractor to demonstrate system performance in accordance with specification requirements.

PART 3 EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITIONS

A. **Examination**. Review the design and installation of the system or equipment to ensure that the proposed test will not result in a hazard to personnel or equipment.

B. **Verification**. Verify that the equipment, component, or system is completely and correctly installed before beginning tests.

3.2 PREPARATION

A. **Prior Preparation**. Design, fabricate, and install test equipment before commencing the test.

B. **Notification**. Notify and obtain approval of the Engineer/Architect prior to each test.

3.3 TESTING, ADJUSTING, AND BALANCING

A. Dry Testing

1. All equipment and systems shall be tested, adjusted, aligned, lubricated, and balanced in accordance with the manufacturer's instructions prior to testing.

2. Test individual components prior to testing the system of which they are a part.

B. Wet Testing

1. After dry testing, wet test all equipment and systems for a minimum of 72 hours under the design operating conditions utilizing a test material similar to or the same as the process material.

2. All costs, including materials and equipment, for delivery of the test material shall be at the Contractor's expense. Test each component or item of equipment to demonstrate compliance with the design criteria and operating range specified.

3. Suspend or secure all tests in the event that test failures or hazardous conditions occur. Make repairs, replacements, or adjustments and restart test in its entirety.

4. The Contractor shall dispose of the test material at no additional cost to the Owner.

5. The Contractor shall clean all equipment systems and structures upon conclusion of testing at no additional cost to the Owner.

6. Comply with any performance testing requirements specified.

3.4 FIELD QUALITY CONTROL

A. **Presence of Engineer/Architect**. The Engineer/Architect or other Owner's Representative must be present during all wet testing; otherwise, the testing shall be repeated.

B. **Failure**. Tests shall be repeated if results of testing fail to meet test criteria, whether the failure is identified in the field at the time of testing or through test report review.

END OF SECTION

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SECTION 01 78 23

MAINTENANCE AND OPERATING INSTRUCTIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall prepare and furnish Maintenance and Operating Instructions for installation, maintenance, and operation of all equipment and associated subsystems and systems as specifically required in Divisions 2 through 46.

1.3 QUALITY ASSURANCE (Not Used)

1.4 SUBMITTALS

A. **General**. The Contractor shall initially submit one copy of the maintenance and operating instructions for review. After approval of the review copy, six copies of the revised instructions shall then be submitted. Each copy shall be bound in an appropriately sized three ring notebook with a cover designating the name of equipment, maintenance, and specification section number. Maintenance and operating instructions for each specification section shall be bound in a separate notebook. Six copies of any revisions shall be submitted for insertion in the notebooks.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Maintenance and Operating Instructions shall include all of the following:

B. **Manufacturer's Data**. Include general descriptive bulletins, brochures, or catalog sheets used to describe the equipment.

C. **Operating Instructions/Operating Sequence Descriptions**. These shall be complete, detailed written descriptions of the operating sequence of all control systems and operations in all modes. The descriptions shall be specifically prepared for this work and shall be fully referenced to control diagrams and system components. The descriptions shall include start-up and shutdown operations under manual, system safety functions.

D. **Manufacturer's Instructions**. This shall include instructions for storage, installation, routine preventive maintenance, and lubrication. This data shall include instructions that describe the proper procedures for moving, supporting, and anchoring of equipment, including tolerances for settings and adjustment. Also included shall be the storage requirements and procedures to protect

products prior to installation, and once installed, prior to start-up/periods of prolonged shutdown, and proper storage of repair parts.

E. **Parts List**. Include assembly, exploded view illustrations, or sectional drawings with all parts identified. Part listings shall include descriptions, quantity (per assembly) required, and original equipment manufacturer's part numbers.

F. **Supplier Data**. Provide addresses, telephone numbers, and names of contact persons for the equipment manufacturer and manufacturer's representative. Include both regional (local) and home offices.

G. **Warranties and Guarantees**. Include terms and conditions of the warranty. Include the manufacturer's express warranty and any special express warranties as specified in individual sections of Divisions 2 through 46 of the Project Manual in addition to the general warranty. Draft warranties shall be submitted with the shop drawing submittals. Final warranties will become effective on the date of substantial completion applicable to the named equipment. Copies of the approved draft warranties are to be included in the initial Maintenance and Operating Instructions submittal. Following substantial completion, copies of the executed final warranties shall be provided for insertion into the final Maintenance and Operating Instructions.

H. **Approved Submittals**. Provide a complete list (including submittal numbers) of all approved submittals pertaining to the Maintenance and Operating Instructions.

I. **Copies** of all materials shipped with the equipment.

J. **Copies** of all approval submittals including control wiring diagrams.

2.2 DEPOT LEVEL INSTRUCTIONS

A. Individual sections of Divisions 2 through 46 of the Project Manual require that Depot Level information be submitted as part of the initial Maintenance and Operating Instructions. Depot level instructions are detailed instructions that would be used by the manufacturer's factory, repair depot, or authorized service center to repair or rebuild an item of equipment or a component, part, or subassembly of an item of equipment deemed by the manufacturer as "not user serviceable." These instructions will be used for both ordinary and major maintenance, and enable the Owner to overhaul or repair equipment in the event parts become unavailable. The following is a list of depot level instructions that are specifically required by individual sections:

B. **Detailed Parts Lists**. In addition to original equipment manufacturer's parts numbers, provide complete part descriptions, sizes, and materials of construction types and/or grades using appropriate industry standard designation codes. Provide universal part numbers for applicable items such as bearings, seals, and gaskets.

C. **Repair Data**. Include instructions for assembly, disassembly, rebuilding, and repair of the equipment or component.

D. **Manufacturing Data**. Scale drawings and supplementary information with complete dimensions, tolerances, finishes, features, materials, and treatments required for procurement of materials and manufacture of the part(s) or equipment.

E. **Electrical Diagrams**. Schematic diagrams, wiring diagrams, point-to-point wiring diagrams, and logic flow diagrams.

F. **Mechanical Diagrams**. Schematic diagrams of pneumatic, hydraulic, and other mechanical systems and piping.

G. **Troubleshooting Data**. Include procedures, forms, or checklists, outlines, and diagnostic aids and information.

H. **Test Data**. Include procedures, readings, and settings for testing and calibration.

I. **Repair Parts and Maintenance Materials**. List replacement parts, special tools, and consumable materials used in cleaning, maintenance, and repair.

J. **Software/Programming Documentation**. This documentation shall be referenced to the Operating Sequence Descriptions and shall include flow charts, program source code listings, and documentation ladder diagrams with detailed descriptions for each rung for the software provided. Information shall be provided to instruct and to familiarize the operator and shall be reviewed with the system programming to enable a step-by-step evaluation of the program. Notations, remarks, and labeling shall be provided on the program source code listing to indicate the program operation and function. Any additional narrative description of the program operation shall be provided to fully describe the system parameters and functionality in a clear and logical manner.

2.3 OTHER INSTRUCTIONS

A. Submit additional information as required by individual sections of Divisions 2 through 46 of the specifications.

PART 3 EXECUTION

3.1 VERIFICATION

A. **General**. The Contractor shall verify the accuracy of Maintenance and Operation Instructions by visual and physical inspection of the installed equipment. The Contractor shall:

1. Perform field verification in the presence of the Owner or Owner's Representative.
2. Notify Engineers 1 week before the scheduled field verification. The Engineer/Architect may require changes in the field verification schedule.
3. Physically trace and document as required all wiring and piping.
4. Visually inspect equipment and components and compare configurations and nameplate information to Maintenance and Operating Instructions.
5. Submit any changes, additions, or deletions to the Maintenance and Operating Instructions identified during field verification.
6. In the event changes are made to the equipment following field verification, the Contractor shall submit a final supplement of approved revisions of the Maintenance and Operating Instructions.

3.2 SHIPPED INSTRUCTIONS

A. Within 2 weeks of equipment delivery, submit copies of maintenance, operation, and installation instructions shipped with the equipment.

END OF SECTION

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SECTION 01 78 40

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and General provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary to maintain and provide the Owner with Project Record Documents.

1.3 QUALITY ASSURANCE (Not used.)

1.4 SUBMITTALS

A. **Project Record Documents**. The Contractor shall submit project record documents, as follows:

1. The Contractor shall submit one set of the Contract Drawings with each sheet labeled "Project Record" and updated as specified.

2. The Contractor shall submit one copy of other contract documents with the cover labeled "Project Record" and updated as specified.

3. The Contractor shall submit one copy of each Record Shop Drawing with each sheet labeled "Project Record" and updated as specified.

4. These requirements for Record Project Documents are in addition to the requirements for the Maintenance and Operating Instructions.

1.5 JOB CONDITIONS (Not used.)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used.)

1.7 SPECIAL WARRANTY (Not used.)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION AND VERIFICATION

A. **Maintenance of Documents**. Maintain in Contractor's field office in clean, dry, legible condition the following: contract drawings, specifications, conforming shop drawings, contract modifications, other modifications of contract, test records, survey data, and all other documents pertinent to Contractor's work.

B. **Files**. Provide files and racks for proper storage and easy access. File in accordance with filing format acceptable to Engineer/Architect.

C. **Availability**. Make documents available at all times for inspection by Engineer/Architect.

D. **Purpose**. Project Record Documents shall not be used for any other purpose and shall not be removed without Engineer/Architect's approval.

3.2 INSTALLATION

A. **Recording Procedure**. Do not permanently conceal any work until required information has been recorded and Engineer/Architect has been given sufficient time to inspect all work.

B. **Update as Construction Proceeds**. Keep all Project Record Documents updated to record construction as actually built and to document all approved changes to the documents. This update information shall include but is not necessarily limited to the following:

1. Contract Drawings. Legibly mark to record actual construction including:

   a. Depths of various elements of foundation in relation to datum.

   b. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.

   c. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.

   d. Field changes of dimension and detail.

   e. Changes made by Change Order or Work Order.

2. Specifications. Legibly mark up each section to record

   a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually incorporated into the work.

   b. Changes made by Change Order or Work Order.

3. Submittals. Prepare and submit one copy of all submittals for the work performed under this Contract. These submittals shall be updated as outlined above. Submittals shall be in legal files with the specification section and title marked on the tab.

END OF SECTION

SECTION 01 79 00

START-UP, DEMONSTRATION, AND TRAINING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. This section includes general requirements for start-up, training, and operational demonstration as required by the specifications.

1.3 QUALITY ASSURANCE

A. Provide all instruments required for testing. Calibrate all test instruments to within appropriate test standards as established by American Society for Testing and Materials (ASTM) or the governing technical standard. Retain calibration data at the Contractor's site office for Owner or Owner's Representative's review.

1.4 SUBMITTALS (Not used)

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

1.8 DEFINITIONS

A. **Operational Demonstration**. Equipment installed by the Contractor, which has passed functional testing as per manufacturer certification, shall be continuously operated by the Owner (while the Contractor maintains and if necessary adjusts the fully-functional components). The minimum operational demonstration period shall be a period of 7 continuous calendar days for new equipment installed in each primary settling tank and each new sludge pump, and one day for each final settling tank.

B. **Field Testing**. Testing performed on-site by the Contractor to satisfy requirements of the manufacturer and Contract Documents.

1. Dry Testing. Dry testing is performed by the Contractor without introducing either process material or other test material into the component, system, or unit process.

2. Wet Testing. Wet testing is performed by the Contractor utilizing test material in the component, system, or unit process. Process tankage shall be filled with test material to operating level.

3. Performance Testing. Performance testing is performed by the Contractor to demonstrate system performance in accordance with specification requirements.

C. **Start-Up**. An activity performed by the manufacturer's representative with the Contractor immediately after equipment or system is completed to verify the installation.

1. Check the installation for conformance with the plans and specifications.
2. Check the installation for conformance with the shop drawings and manufacturer's data.
3. Verify quantities and data with the operation and maintenance (O&M) manuals.
4. Verify that equipment is ready for operation.
5. Place component, system, or unit process on-line.
6. Perform all required field testing.
7. Prepare and submit a manufacturer's representative's report including certification, recommendations, and conclusions.

D. **Training**. To educate Owner's personnel to become qualified and proficient in the operation, maintenance, and repair of the complete system. Training shall include:

1. Classroom instruction.
2. In-plant, on-site demonstration.
3. Equipment demonstration.
4. Actual hands-on operation by the Owner's staff.
5. All training sessions shall be recorded for the Owner to own for their files.

E. **Adjusting**. To install or change setting, parameters, calibrations, flows, processes, etc., so that the equipment or system operates in a logical or more efficient state.

F. **Balancing**. To make equipment or subsystems operate in harmony or equilibrium by adjusting, altering, or modifying parts of the system.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 START-UP EXECUTION

A. Start-Up Preparation

1. Prior to beginning a start-up, inspect the systems and equipment to verify their readiness to begin with the manufacturer's representative.
2. Correct hazardous conditions to equipment or personnel prior to start-up of equipment.
3. Do not proceed with start-up operations using temporary power or temporary instrumentation and control wiring unless approved. All electrical and control connections shall be permanent and complete, and all such electrical components and equipment fully functional.
4. Design, fabricate, and install all necessary testing and monitoring equipment before commencing the test.

a. Quality. Use materials and equipment of good quality and suitable for the intended service. The use of miscellaneous items found at the job site is not acceptable.

b. Maximum Gauge Readings. Select capacity or range of test equipment to provide meaningful test results. Select pressure or differential pressure gauges so that test pressure is 50 percent to 75 percent of maximum gauge reading.

c. Temporary Equipment. Fabricate, as necessary, any temporary equipment used in testing. This equipment shall remain the property of the Contractor who will remove it from the site upon substantial completion.

5. Manufacturer's representative(s) shall be present for the initial start-up of all systems or equipment.

6. Request permission to start up equipment, including electrical gear, and notify the Engineer/Architect of the start-up.

a. Submit the start-up request a minimum of 72 hours before the scheduled start-up. Make requests in writing during normal working hours.

b. Start-up request shall be in accordance with Section 01 33 00, "Submittals."

c. The Owner and/or Engineer/Architect shall have the right to reject the use of an individual for facility start-up.

d. Approval of the request is based solely on impact on plant operations. Approval does not relieve the Contractor of any responsibility for plant and personnel safety.

e. Coordinate the start-up of each piece of equipment with the Owner and the Engineer/Architect so that operation does not interfere with the normal operation of the facility.

7. Normal installation checks, such as for rotation, are not considered start-ups and do not require start-up notification. Clearly mark all electrical apparatus which is energized.

B. Conduct of Start-Up

1. Equipment Adjustments. Make all adjustments, corrections, and calibrations to set points, process parameters, etc., necessary to achieve normal, stable operation of systems.

2. Equipment Failure. Consider any failures of equipment or systems as deficiencies and correct them. Stop testing and the start-up until all deficiencies have been corrected.

3. System Failure.

a. When there appears to be a system failure and the system is composed of separate but functionally codependent individual pieces of equipment and check-out of each piece of equipment by its respective manufacturer's representative verifies that the equipment is functioning properly, then the Contractor's remains responsible for overall system operation.

b. Verify compatibility of equipment during the submittal process to minimize overall system operating problems.

c. Reconfigure, repair, modify, or replace parts or all the equipment in order to provide a system that shall perform as specified at no additional cost to the Owner.

4. Dry Testing.

a. Test, adjust, align, lubricate, and balance all equipment and systems in accordance with the manufacturer's instructions prior to testing.

b. Test individual components prior to testing the system of which they are a part.

5. Wet Testing.

a. After dry testing, wet test all equipment and systems for a minimum of 72 hours under the design operating conditions utilizing a test material similar to or same as the process material.

b. All costs, including materials and equipment, for delivery of the test material shall be at the Contractor's expense. Test each component or item of equipment to demonstrate compliance with the design criteria and operating range specified.

c. Suspend or secure all tests in the event that test failures or hazardous conditions occur. Make repairs, replacements, or adjustments and restart test in its entirety.

d. Dispose of the test material at no additional cost to the Owner.

e. Clean all equipment systems and structures upon conclusion of testing at no additional cost to the Owner.

f. Comply with any performance testing requirements specified.

6. Retesting. Repeat tests if results fail to meet test criteria, whether the failure is identified during field testing or through reviewing the test report later.

7. Performance Testing. Verify operating ranges, capacities, low and high limits, efficiencies, temperatures, speeds, pressures, sequences, etc., of each piece of equipment being tested. Check monitors, indicators, alarms, and fail-safe devices.

8. Do not use repair parts during start-up operations unless approved.

9. Furnish all lubrication and operating fluids per the manufacturer's instructions.

10. Field-verify initial copy of O&M manual according to Section 01 33 00, "Submittals."

C. **Start-Up Conclusion**. Submit manufacturer's representative's report within 48 hours of conclusion of each start-up. Report shall be in accordance with Section 01 33 00, "Submittals."

3.2 OPERATIONAL DEMONSTRATION EXECUTION

A. **Operational Demonstration Preparation**. Prior to the operational demonstration beginning:

1. Complete start-up procedures including submitting all reports for all parts of the work designated for the operational demonstration.

2. Complete all required construction activities, including any activities by any entity that would interrupt the normal operations of the demonstration.

3. Ensure that adequate parts and supplies for routine maintenance and replacement are on hand to support system operation through the demonstration period.

4. Deliver all repair parts to the Owner.

5. Submit an operational demonstration request according to Section 01 33 00, "Submittals," 48 hours prior to start of operational demonstration.

B. Conduct of Operational Demonstration

1. During the operational demonstration and at other times, the work will be on-line and an integral part of the plant operations and process. The Owner maintains control of plant operations and processes at all times. Therefore:

   a. Do not commence, resume, modify, terminate, or suspend the operations without the permission of the Owner and only in a sequence and manner suitable to the Owner except in the case of an emergency.

   b. The operation of the work shall be in strict accordance with the operational orders of the Owner.

   c. Adjust or repair immediately, on a 24-hour-per-day, 7-day-per-week basis, any malfunction in the work which in the opinion of the Owner jeopardizes or may jeopardize the proper operation of the total facility.

2. Perform operational demonstrations of the entire work. With approval, individual systems may be independently demonstrated as long as their complete range of operation and performance can be shown without the rest of the facility.

3. Update. Keep the log on-site during the operational demonstration and updated on a regular basis. The log shall be available for review by the Owner or Owner's Representative at all times during the operational demonstration.

4. Maintenance. Perform all required maintenance and servicing during the operational demonstration at the specified intervals and as necessary. Note all maintenance and servicing in the operational demonstration log.

5. Time.

   a. The operational demonstration shall last for a period of 30 consecutive days.

   b. All equipment and systems shall remain totally operational during this period.

   c. Upon successful completion of the operational demonstration, the work is considered to be ready for its intended use, and the

Contractor may make recommendation for substantial completion.

d. Outages.

1) Note all outages of equipment, system(s), or the plant in the operational demonstration log.

2) Plant power outages such as power failure, process failure or existing equipment, and planned outages of existing systems for cleaning, maintenance, or repair are considered a part of normal plant operation and will not invalidate the operational demonstration.

3) Be responsible for the safe and orderly shutdown and restart of equipment as necessary in the event of an outage.

4) Do not include outage time in the demonstration time period.

e. Do not count activities such as filling, draining, purging, heating or cooling to temperature, stabilizing, adjusting, testing, or other start-up activity time as operational demonstration time.

f. Failed Operational Demonstration.

1) If, during the operational demonstration, any part of the work fails to fully conform to the requirements of the Contract Documents, consider the operational demonstration to have failed, and the work not to be substantially complete.

2) Upon failure of the operational demonstration, promptly remedy any defects in the work and promptly reschedule and restart the complete operational demonstration time period. No operational demonstration time will be considered to have accrued to any part of the work by reason of a failed operational demonstration.

g. Suspension of Operational Demonstration.

1) During the operational demonstration, the Owner may require or permit the operational demonstration to be suspended upon the written request of the Contractor to correct or adjust the work, when in the judgement of the Owner or Owner's Representative such required correction or adjustment is insufficient to deem the operational demonstration to have failed.

2) If an operational demonstration is suspended for any reason except failure, operational demonstration time shall accrue to the work from the time of the beginning of the operational demonstration to the time of the suspension. No operational demonstration time shall accrue during the period of suspension.

3) If an operational demonstration is suspended at the request of the Contractor, continue operation and maintenance of the work without additional charges to the Owner, according to all provisions of this section of the specifications, and to the extent required by the Owner.

6. O&M Manuals. Start-up and operation of the system and all associated equipment shall be in accordance with the O&M manuals. If deviations from the manuals are necessary, note these in the operational demonstration log, and subsequently submit as revisions to the O&M manuals.

7. Personnel and Consumables.

a. Have sufficient personnel available during the entire demonstration to ensure proper maintenance, adjusting, troubleshooting, and any and all repairs to equipment, controls, etc., to maintain and keep the entire facility operating continuously for 30 consecutive days (720 hours).

b. The Owner will remain in control of the facility processes and provide the manpower to operate the facility.

c. The Owner will furnish all consumable supplies and power required for the 30 day complete facility operational demonstration.

d. Contractor's Supervision. When Owner personnel are operating systems or equipment under supervision of the Contractor during operational demonstration, make available, at all times, persons knowledgeable about the systems or equipment to direct the Owner personnel in its operation.

1) To the extent possible, operate all equipment or individual components throughout their range during this period.

C. Operational Demonstration Completion

1. Within 2 weeks of the termination or completion of the operational demonstration, submit for approval:

a. Any changes to O&M Instructions.

b. The completed operational demonstration logs according to Section 01 33 00, "Submittals."

2. The Owner will not assume full responsibility for operation and maintenance of the system and equipment until successful completion of the operational demonstration and all conditions for substantial completion have been satisfied and both the Contractor and Owner have accepted the Certificate of Substantial Completion.

3.3 TRAINING EXECUTION

A. **Training Preparation**. Coordinate and verify to ensure that, prior to the scheduled training time(s):

1. The equipment is ready for operation and has completed its start-up.
2. That all associated construction required to operate the equipment in all normal and anticipated operating modes is complete.
3. That the equipment area is safe, well lit, and unobstructed, so that all training class attendees may access, hear, view, and participate in the training.
4. That the equipment area is free of construction activities that could present a hazard to training class participants.
5. That adequate training materials, as required, are on hand for use during the training session.
6. Any representatives of interfacing Prime Contractors, subcontractors or equipment suppliers needed to perform supporting operations allowing demonstration of equipment operation, have been notified and will be available.
7. Schedule training sessions through Owner and the Engineer/Architect. Cooperate with the Owner in scheduling all required training sessions.
8. Verify that the training materials are compatible with this equipment. Provide other audio/visual equipment and training aids as needed.
9. The approved O&M manuals shall be available and frequent reference shall be made to the equipment O&M manuals.
10. The instructor's qualifications, the training schedule, the lesson plan, and any instructional materials have been submitted and approved before training begins. Submittals shall be in accordance with Section 01 33 00, "Submittals."
11. Training schedules should be submitted far enough in advance that the Owner can adjust work schedules so that all participants are available for the training sessions.

B. Conduct of Training

1. Provide at least one copy of instructional materials used for training at the time of the first training session for each attendee.
2. Before the training is complete, have all training session attendees sign an attendance sheet.
3. Discuss all items of the approved lesson plan in the classroom or the field, in complete and sufficient detail to allow the Owner's operating personnel to knowledgeably operate and maintain the equipment in accordance with manufacturer's recommended procedures and safety considerations during all anticipated operational and maintenance situations.
4. Address safety concerns and features intended to enhance safety.
5. Address tasks required to maintain the warranty.
6. The Owner reserves the right to record the training session for the future use in training employees.

7. Address all questions and comments as they are raised by the training session participants to the maximum extent practicable. If questions or comments cannot be addressed during the training session, additional materials and/or training may be required.

8. O&M material and instructional material shall not conflict.

C. **Training Conclusion**. Within 2 weeks of the training being completed:

1. Correct, revise, and update the O&M manuals as necessary to agree with training.

2. Submit completed sign-in sheet in accordance with Section 01 33 00, "Submittals."

END OF SECTION

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SECTION 01 86 01

BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this and the other sections of Divisions 22 and 23.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Sections 23 09 00 and 23 09 93, "Instrumentation and Controls" and "Sequence of Operation," for controls and interlocks.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to construct the project in accordance with the plans and as specified herein.

1. Controls, interlocks, and their wiring systems are work of Division 23.

B. **This section includes general administrative** and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this section to expand the requirements specified in Division 1:

1. Submittals.
2. Coordination drawings.
3. Record documents.
4. Maintenance manuals.
5. Rough-ins.
6. Mechanical installations.
7. Cutting and patching.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data. Furnish test reports and material certifications where required by the sections in Divisions 22 and 23.

B. **Follow the procedures specified** in Division 1 section "Submittals."

C. **Quantity.** Increase, by the quantity listed below, the number of mechanical related shop drawings, product data, and samples submitted, to allow for required distribution.

1. Shop Drawings - Initial Submittal. One additional blue or black line prints.

2. Shop Drawings - Final Submittal. One additional blue or black line prints.

3. Product Data. One additional copy of each item.

4. Samples. One addition as set.

D. **Additional Copies.** Additional copies may be required by individual sections of these specifications.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery.** Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 SPECIAL WARRANTY (Not Used)

1.8 COORDINATION DRAWINGS

A. **Coordination drawings** are required for the following buildings:

1. Collection Maintenance

2. Laboratory

3. Secondary Operations

B. **General.** Prepare coordination drawings in accordance with Section 01 33 00 "Submittals," to a scale of 3/8"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:

a. Clearances for installing and maintaining insulation.

b. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.

c. Equipment connections and support details.

d. Exterior wall and foundation penetrations.

e. Fire rated wall and floor penetrations.

f. Sizes and location of required concrete pads and bases.

g. Valve stem movement.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling mounted items.

1.9 RECORD DOCUMENTS

A. **General.** Prepare record documents in accordance with the requirements in Section 01 78 40, "Project Record Documents." In addition to the requirements specified in Division 1, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.

2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Section 22 05 53, "Mechanical Identification." Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

4. Approved substitutions, contract modifications, and actual equipment and materials installed.

5. Contract modifications, actual equipment and materials installed.

B. **Invert Elevations.** Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located to record the locations and invert elevations of underground installations.

1.10 MAINTENANCE MANUALS

A. **General.** Prepare maintenance manuals in accordance with Section 01 78 00, "Project Closeout." In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. Clearly mark applicable portions of manufacturer's literature and cross out all information not pertinent to products provided.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Provide tabbed sections for each item of equipment and a table of contents for each tabbed section.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. **Rough-in Measurements.** Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. **Location of Requirements.** Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 PREPARATION

A. **General**. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

4. Coordinate the installation of supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

3.3 ERECTION/INSTALLATION/APPLICATION

A. **General.** Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer/Architect.

B. **Orientation**. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

C. **Location**. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

D. **Access Panels**. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Section 01 86 03, "Basic Mechanical Materials and Methods."

E. **Conflicts**. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

F. Cutting and Patching

1. General. Perform cutting and patching in accordance with Section 01 73 29, "Cutting and Patching." In addition to the requirements specified in Division 1, the following requirements apply:

a. Protection of Installed Work. During cutting and patching operations, protect adjacent installations.

2. Examples. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

a. Uncover work to provide for installation of ill timed work.

b. Remove and replace defective work.

c. Remove and replace work not conforming to requirements of the Contract Documents.

d. Remove samples of installed work as specified for testing.

e. Install equipment and materials in existing structures.

f. Upon written instructions from the Engineer/Architect, uncover and restore work to provide for Engineer/Architect observation of concealed work.

3. Removal of Existing Work. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new work.

3.4 PROTECTION

A. **Protect Remaining Work.** Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

B. **Dust Protection.** Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1. Patch existing finished surfaces and building components using new materials matching existing materials and experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

2. Patch finished surfaces and building components using new materials specified for the original installation and experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION

SECTION 01 89 19

LEAKAGE TEST AND DISINFECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to perform the leakage tests and disinfection of pipes, equipment, and tanks in accordance with the drawings and the specifications.

1.3 QUALITY ASSURANCE

A. Materials and workmanship shall be in accordance with the following standards as referenced herein:

1. **AWWA**. American Water Works Association.
2. **ASTM**. American Society for Testing and Materials.
3. **ACI**. American Concrete Institute.

1.4 SUBMITTALS

A. **Test Reports**. Submit test results of all testing included in this section including, but not limited to, the following:

1. Pressure tests.
2. Tests for efficacy of disinfection.

1.5 JOB CONDITIONS. (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions under which the pipe section, facility, or part of a facility is to be tested or disinfected and verify that conditions are satisfactory and ready for the test to proceed.

3.2 PREPARATION

A. **Protection**. Protect adjacent equipment, materials, piping, and valving against drainage from testing and/or disinfection.

B. **Notification**. Notify the Engineer at least 24 hours prior to any testing and/or disinfecting. Notify the Owner at least 48 hours prior to any disinfecting. Notify the Engineer immediately of all unsatisfactory or nonconforming conditions.

C. **Responsibility**. Beginning the test means acceptance of all the existing surfaces and conditions.

3.3 PRESSURE MAIN AND PROCESS PIPING LEAKAGE TESTING

A. **Description**. Provide the leakage tests as directed and as specified herein. Furnish gauges for the tests with the most recent gauge calibration test report available for review on-site.

B. **Test Section**. No test section shall be longer than 500 feet without approval.

C. **Leakage Allowances** (unless noted otherwise)

1. Pressure Mains. The maximum leakage allowance for all pressure mains shall be 10.49 gallons per inch diameter per mile of pipe per 24 hours.

2. Process Piping Including Air Piping. No leakage is acceptable.

D. **Test Procedure**

1. Slowly fill each pressure main or process piping section with water to the specified test pressure in a satisfactory manner.

2. Before applying the specified test pressure, expel all air from the pipe.

3. Maintain the test water pressure for at least 2 hours.

4. Determine leakage by measuring the quantity of water added to the main to maintain the specified test pressure.

5. Unless noted otherwise, minimum test water pressure shall be the greater of 1.5 times the working pressure or the following:

a. Mains or process piping carrying water – 150 pounds per square inch (psi).

b. Force mains – 100 psi.

c. Other pressure mains – 100 psi.

E. **Air Piping Test Procedure**

1. Backfill the section of air main to be tested prior to testing.

2. Test each valved section of air main with air at the specified test pressure by means of a compressor connected to the main in a satisfactory manner.

3. Bring the air pressure to 150 percent of the system's blower(s) shutoff head (but in no case greater than the pressure rating of the pipe) unless otherwise noted and maintain for at least 2 hours.

4. Determine leakage by comparison of initial and final pressure gauge readings.

3.4 DISINFECTION

A. **General**

1. Thoroughly clean, flush, and disinfect pipes, tanks, and equipment designed to carry water for domestic consumption before acceptance by the Owner.

2. Engineer will confirm that the item to be disinfected is thoroughly

cleaned and flushed prior to disinfection.

3. Disinfection shall be done by the addition of suitable amounts of chlorine in the form of liquid chlorine or high test hypochlorite of lime.

4. The application shall be as approved by the Owner and in accordance with the appropriate AWWA standard listed below.

    a. Water mains are under AWWA C651.

    b. Water storage tanks are under AWWA C652.

    c. Water treatment plants are under AWWA C653.

5. Perform tests for efficacy of disinfection, and repeat disinfection and tests as needed at no cost to the Owner.

6. Dispose of heavily chlorinated water in accordance with AWWA C651 and AWWA C651 Appendix II, and not to a sanitary sewer or the environment unless dechlorinated sufficiently to not interfere with treatment of sanitary sewage or the environment.

3.5 SANITARY SEWER LEAKAGE TESTING

A. **Test Section**. A sanitary sewer test section shall be from the inlet end of the downstream manhole to the outlet end of the upstream manhole, including all laterals in the sewer.

B. **Leakage Allowance** (unless noted otherwise). The maximum leakage allowance for all sanitary sewers shall be 100 gallons per inch diameter per mile of pipe per 24 hours.

C. **Test Procedure**. Use either an infiltration water test, exfiltration water test, or a low-pressure air test for gravity sewers after backfilling is completed.

1. Infiltration.

    a. The infiltration test may be selected when the height of the groundwater table is 2 feet or more above the top of the pipe barrel, including house services, at the highest point of the section.

    b. Measure the amount of infiltration by means of a weir located in the downstream manhole, and the amount shall not exceed the allowable leakage.

    c. Securely seal the inlet end of the upstream manhole.

    d. Maintain the test head for a period of not less than 24 hours before the weir measurement is made.

2. Exfiltration.

    a. When the exfiltration test is selected, close the inlet ends of the upstream and downstream manholes with a watertight bulkhead.

    b. Fill the sewer along with the upstream manhole with water until the elevation of the water in the upstream manhole is 2 feet higher than the top of the pipe barrel, including house services, in the section being tested, or 2 feet above the existing

groundwater in the trench, whichever is the higher elevation.

c. Fill and maintain the entire length of section to be tested full of water for a period of approximately 24 hours prior to the start of the test.

d. If the water level in the upper manhole has dropped during this 24 hour period, raise the level to the test elevation mark prior to measurement of leakage.

e. Determine the exfiltration by measuring the amount of water required to maintain the above stated water elevation for a period of 2 hours from the start of the test.

f. The allowable leakage is based on a maximum difference in elevation of 8 feet between the level of water at the upper manhole and the invert of the pipe being tested in the lower manhole.

g. If the difference in elevation exceeds 8 feet, increase the allowable leakage 5 percent for each 1 foot in excess of 8 feet.

3. Low-Pressure Air Test. Testing shall meet the requirements of the following standards.

Pipe Material	Testing Standard
Concrete Pipe (24” & under)	ASTM C 924
Concrete Pipe (over 24”)	ASTM C 1103
Clay Pipe	ASTM C 828
Plastic Pipe	ASTM F 1417
All Others	ASTM F 1417

D. **Manhole and Precast Wet Wells Leakage Testing**

1. Vacuum-test all sanitary manholes for leaks, instead of the water testing specified above.

2. The vacuum test method shall be in accordance with ASTM C 1244, except as specified otherwise herein.

3. Furnish all equipment and labor required, including necessary piping/hoses, pneumatic plugs, test vacuum equipment (vacuum pump and vacuum plate/head), vacuum gauge, and second timer. The vacuum gauge shall have a maximum range of 0 to 30 inches of mercury (Hg) and the vacuum gauge figure intervals shall be in 1/2-inch increments.

4. Perform the vacuum test witnessed by the Engineer.

5. Remove all pneumatic plugs after the test.

3.6 STORAGE TANK LEAKAGE TESTING

A. Demonstrate water tightness of all liquid- bearing tanks in accordance with ACI 350.1, "Tightness Testing of Environmental Engineering Concrete Structures."

3.7 FIELD QUALITY CONTROL

A. **Field Tests**

1. Provide all test materials, equipment, chemicals, and water required for testing or disinfection at no additional cost to the Owner.

2. Perform testing according to the methods described in this section.

B. **Witness**

1. All leakage tests shall be witnessed and approved before acceptance.

2. Any test performed without witness by the Engineer, may require retesting the section in conformance with this specification at no cost to the Owner.

C. **Test Results**

1. If the field tests show excessive leakage, repair, adjust, modify, or replace the noncomplying sections until the tests are successfully completed.

2. If the field tests show noncompliance with the disinfection requirements, repeat the disinfection procedure until the tests are successfully completed.

3. This shall be done at no additional cost to the Owner.

3.8 CLEANING AND DISPOSAL

A. Remove and dispose of all excess material and debris as a result of the work completed under this section, including testing procedures.

3.9 PROTECTION

A. **Protect the sections tested** and approved, but prior to acceptance by the Owner.

B. **Protection of the tested** and approved piping sections shall include provisions during installation and testing of nearby piping, valving, or other adjacent equipment.

C. **Remove all protective measures** installed at completion and acceptance of the project.

END OF SECTION

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SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, and equipment necessary to remove and salvage or dispose of the structures or portions thereof in accordance with the plans and specifications.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS.

A. Submit the following submittal packages in accordance with the Division 1 Submittal Requirements and the requirements of this specification section.

B. Submittal Package No. 1 – Demolition Package

1. Package Contents. A proposed schedule of demolition for the purposes of coordinating shutoff, capping, and continuation of utility services as required to operate the facility.

1.5 JOB CONDITIONS

A. **Beginning Work**. Vacate structures to be demolished and discontinue their use prior to start of work.

B. Protection

1. Structural. Prior to the removal of any wall, beam, or column, or cutting of any openings, examine the existing structure and, when required, protect the structure by shoring, bracing, or underpinning.

2. Equipment and Tanks. Protect all equipment and tanks from dust, dirt, debris, and damage by covering with planking and tarpaulins during demolition.

3. Ensure safe passage of persons and vehicles around area of demolition. Conduct operations to prevent damage to adjacent buildings, structures, and other facilities and injury to persons.

C. **Explosives**. Do not use explosives.

1.6 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 60 00.

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify the actual areas, structures or parts of structures, pipes, or other items to be demolished in the presence of the Owner and Engineer/Architect.

3.2 PREPARATION

A. **Equipment and Manpower**. Have all required equipment and staff available at the job site prior to beginning of demolition. This includes any special equipment to permit continued uninterrupted Owner operations as required.

B. **Coordination**. Provide adequate but no less than 48 hours of notice when any Owner operations are affected by demolition.

3.3 DEMOLITION

A. **Demolition Schedule**. Perform demolition work in accordance with the final approved schedule of demolition.

B. **Selective Demolition**. Perform selective demolition work in a systematic manner. Use such methods as required to complete work shown in accordance with demolition schedule and governing regulations.

1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
2. Promptly remove debris and locate demolition equipment to avoid imposing excessive loads on supporting walls, floors, or framing.
3. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
4. Demolish foundation walls and below grade concrete slabs. Demolish and remove below grade wood or metal construction.
5. Cut off piles 1 foot below finished grade.
6. Remove all exposed reinforcing steel unless noted otherwise.
7. For slabs, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible. Saw-cut a minimum of 3 inches deep around perimeter of portions of slabs to be removed.
8. Completely fill below grade areas and voids resulting from demolition work.

C. Miscellaneous

1. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict.
2. Submit report to Owner's Representative in written, accurate detail.
3. Pending receipt of directive from Owner's Representative, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

D. **Salvage**. Remove with care, clean, and store all material and equipment designated to be salvaged in an approved area at the site.

E. Openings

1. Concrete. Close concrete openings using a non-shrink, non-metallic grout.

2. New. Neatly cut or drill new openings to prevent face chipping or spalling. Repair all damaged areas to a condition equivalent to that which existed prior to the start of work.

F. Patching Concrete

1. Repair all concrete that has been marred, damaged, or defaced as a result of demolition.

2. Procedure. Repair concrete surfaces as follows:

a. Saw cut and remove concrete to a depth of not less than 1 inch.

b. Remove exposed reinforcing where noted.

c. Apply an approved bonding agent to the cut surface.

d. Patch with a non-shrink, non-metallic grout finished to match the existing surface unless noted otherwise.

G. **Anchors**. Cut all embedded anchors of removed items flush with the existing surface.

H. **Pipe**. Plug all abandoned pipe at each end.

I. **Cleanup**. Remove from the site all debris, rubble, unusable materials, and items not salvaged.

END OF SECTION

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SECTION 02 41 16

BUILDING DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to perform building demolition in accordance with the plans and specifications.

B. **Removal or Disposal**. This section requires removal and disposal, off-site, of the following:

1. Building structure as shown, except the items listed below which the Owner will remove prior to start of work.

2. Building foundations and supporting walls, unless otherwise noted.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS

1.5 Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

A. Submittal Package No. 1 – Schedule and Documentation

1. Package Contents.

a. Proposed schedule of operations coordination for shutoff, capping, and continuation of utility services as required. Provide a detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.

b. Photographs of existing adjacent structures and site improvements that might be misconstrued as damage related to removal operations. Document location where each photograph was taken and date. File with Owner's Representative prior to start of work.

c. Elevation control survey of existing adjacent structures.

1.6 JOB CONDITIONS

A. **Occupancy**. The Filter Building shall remain in operation during demolition activities.

B. **Condition of Structures**. Owner assumes no responsibility for actual condition of structures to be demolished. Conditions existing at time of inspection for bidding purpose will be maintained by Owner insofar as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work.

C. **Salvaged Materials**. Remove items of salvable value from structure as work progresses. Transport salvaged items from site as they are removed. Do not store or sell removed items on-site.

D. **Explosives**. Do not use explosives.

E. Traffic

1. Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

2. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

3. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

F. **Protection**. Ensure safe passage of persons around area of demolition. Conduct operations to prevent damage to adjacent buildings, structures, and other facilities and injury to persons.

1. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of adjacent facilities to remain, and uncontrolled collapse of structures to be demolished.

G. **Damage**. Promptly repair damage caused to adjacent facilities by demolition operations.

H. **Utility Services**. Maintain existing utilities indicated to stay in service and protect against damage during demolition operations.

1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and governing authorities.

2. Owner will shut off utilities serving structures. Disconnecting and sealing indicated utilities before starting demolition operations are part of this work.

1.7 DELIVERY, STORAGE, AND HANDLING (Not used)

1.8 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 DEMOLITION

A. Pollution Controls

1. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air.

2. Comply with governing regulations pertaining to environmental protection.

3. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

B. **Clean adjacent structures and improvements** of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

C. **Building Demolition**. Demolish buildings completely and remove from site. Use such methods as required to complete work within limitations of governing regulations.

1. Remove small structures intact when acceptable and when approved.
2. Proceed with demolition in systematic manner, from top of structure to ground. Complete demolition work above each floor or tier before disturbing supporting members on lower levels.
3. Demolish concrete and masonry in small sections.
4. Remove structural framing members and lower to ground by hoists, derricks, or other suitable methods.
5. Break up and remove concrete slabs on-grade, unless otherwise shown to remain.
6. Locate demolition equipment throughout structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

D. Belowgrade Construction

1. Demolish foundation walls and other belowgrade construction, including concrete slabs.

E. Filling Basements and Voids

1. Completely fill belowgrade areas and voids resulting from demolition of structures in accordance with Section
31 23 00, “Excavation Backfill, and Embankment."
2. After fill placement and compaction, grade surface to meet adjacent contours and to provide flow to surface drainage structures.

3.2 SALVAGED MATERIALS

A. **General**. Carefully remove items shown to be incorporated in the new work or to be delivered to the Owner to avoid damage. Remove all other material and items from the site with further disposition at Contractor's option.

3.3 DISPOSAL OF DEMOLISHED MATERIALS

A. General

1. Remove weekly from site accumulated debris, rubbish, and other materials resulting from demolition operations.
2. Burning of combustible materials from demolished structures will not be permitted on-site.

B. **Removal**. Transport and legally dispose of off-site materials removed from demolished structures.

END OF SECTION

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SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to perform selective demolition in accordance with the plans and specifications.

B. **Removal and Disposal**. This section requires the selective removal and subsequent off-site disposal of the following:

1. Portions of existing building as shown and as required to accommodate new construction.

2. Removal of stairs, ladders, grating, and cover plates as shown.

3. Removal of doors and frames indicated "remove."

4. Removal of exterior insulated metal wall panels indicated "remove."

5. Removal of existing windows indicated to be bricked in.

6. Removal and protection of existing fixtures, materials, and equipment items indicated "salvage." See Part 3.3 in this Section.

C. Removal Work Specified Elsewhere

1. Roofing and roof insulation removal is specified in Division 7.

2. Cutting holes in roof deck for installation of new rooftop mechanical equipment.

D. Related Work Specified Elsewhere

1. Patching is included within the respective sections of specifications, including removal of materials for reuse and incorporation into remodeling or new construction.

1.3 QUALITY ASSURANCE (Not used)

1.4 SUBMITTALS

A. Submit the following submittal packages in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Demolition Schedule and Documentation

1. Package Contents.

a. Schedule indicating proposed sequence of operations for selective demolition work to Owner's Representative for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1) Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.

2) Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed new addition.

b. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. Document location where each photograph is taken and date. File with Owner's Representative prior to start of work.

c. Elevation control survey of existing adjacent structures.

1.5 JOB CONDITIONS

A. Occupancy

1. Owner will occupy portions of the building immediately adjacent to areas of selective demolition.

2. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations.

3. Provide minimum of 72 hours' advance notice to Owner of demolition activities that will affect Owner's normal operations.

4. Other restrictions related to the disruption to the Owner and restrictions on the Contractor's work are shown or listed below.

B. Condition of Structures

1. Owner assumes no responsibility for actual condition of items or structures to be demolished.

2. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable.

3. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.

C. Partial Demolition and Removal

1. Remove items indicated to be removed but of salvageable value from structure as work progresses.

2. Transport salvaged items from site as they are removed.

3. Do not store or sell removed items on-site.

D. **Protection**. Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.

1. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to occupied portions of building.

2. Erect temporary covered passageways as required by authorities having jurisdiction.

3. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of adjacent facilities or work to remain, and uncontrolled collapse of structure or element to be demolished.

4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.

5. Protect floors with suitable coverings when necessary.

6. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.

7. Provide temporary weather protection between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.

8. Remove protection at completion of work.

E. **Damage**. Promptly repair damage caused to adjacent facilities by demolition work.

F. Traffic

1. Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

2. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction.

3. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

G. **Flame Cutting**. Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

H. Utility Services

1. Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

2. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction.

3. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

4. Maintain fire protection services during selective demolition operations.

I. Environmental Controls

1. Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration.

2. Comply with governing regulations pertaining to environmental protection.

3. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 PREPARATION

A. **General**. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.

1. Cease operations and notify Owner's Representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

2. Cover and protect furniture, equipment, and fixtures from soilage or damage when demolition work is performed in areas where such items have not been removed.

3. Erect and maintain dustproof partitions and closures as required to prevent spread of dust or fumes to occupied portions of the building.

a. Where selective demolition occurs immediately adjacent to occupied portions of the building, construct dustproof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound deadening insulation.

b. Provide weatherproof closures for exterior openings resulting from demolition work.

4. Locate, identify, stub off, and disconnect utility services that are not indicated to remain.

5. Provide bypass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours' advance notice to Owner if shutdown of service is necessary during changeover.

3.2 DEMOLITION

A. **General**. Perform selective demolition work in a systematic manner. Use such methods as required to complete work shown in accordance with demolition schedule and governing regulations.

1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.

2. Promptly remove debris and locate demolition equipment to avoid imposing excessive loads on supporting walls, floors, or framing.

3. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.

4. Demolish foundation walls and belowgrade concrete slabs. Demolish and remove belowgrade wood or metal construction.

5. Cut off piles 1 foot below finished grade.

6. Remove all exposed reinforcing steel unless noted otherwise.

7. For slabs, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible. Saw-cut a minimum of 3 inches deep around perimeter of portions of slabs to be removed.

8. Completely fill belowgrade areas and voids resulting from demolition work as specified in Section 31 23 00 "Excavation, Backfill, and Embankment."

B. Miscellaneous

1. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict.

2. Submit report to Owner's Representative in written, accurate detail.

3. Pending receipt of directive from Owner's Representative, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.3 SALVAGED MATERIALS

A. Salvaged Items

1. Where shown as incorporated in new construction or "Salvage - Deliver to Owner," carefully remove indicated items, clean, package to prevent damage, store, and promptly turn over to Owner. A list of items to be “Salvage – Deliver to Owner” include the following:

a. Filter Gallery Valve Operators

b. PLC Hardware

c. Work Stations

d. Network Devices

e. Servers

2. Obtain receipt.

3. Historic artifacts, including cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historic significance, remain property of Owner.

4. Notify Owner's Representative if such items are encountered and obtain acceptance regarding method of removal and salvage for Owner.

3.4 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from building site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose of off-site.

B. **Hazardous materials encountered** during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

C. **Do not burn** removed materials on project site.

3.5 CLEANUP AND REPAIR

A. General

1. Upon completion of demolition work, remove tools, equipment, and demolished materials from site.

2. Remove protections and leave interior areas broom clean.

3. Repair demolition performed in excess of that required.

4. Return elements of construction and surfaces to remain to condition existing prior to start of operations.

5. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION

SECTION 02 61 20

TANK AND CHANNEL CLEANING

PART 1 PART 1 - GENERAL

1.1 RELATED DOCUMENTS.

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

B. **Related Sections.** The following sections contain requirements related to this section.

1. Section 01 74 23, “Cleaning.”

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to accomplish cleaning of tanks and channels in accordance with the drawings and as specified herein. All solids/sediment shall be removed from the below tanks and channels and/or structures in addition to cleaning as specified in Section 01 74 23 “Cleaning”.

1. The Tanks and channels and/or Structures to be cleaned are:

a. Washwater Reservoir

b. Chlorination Chamber

c. Clearwell 1A & 1B

d. Clearwell 2A & 2B

e. Clearwell 3A & 3B

f. High Service Pump Chamber 1 & 2

g. West Aerator Building

h. East Aerator Building

2. Prior to solids/sediment removal, Contractor shall remove any trash from tanks or channels and dispose in landfill under the lump sum as detailed on the Bid Form.

3. Material to be removed and disposed consists of sediment, sand, and other solids remaining in treatment tanks after all the free-draining liquid has been removed. The residual solids removed from the WTP structures shall be hauled to the washwater lagoon designated for use during Construction as approved by Engineer/ Owner.

4. Residual solids stored in the designated lagoon during construction shall be disposed as described in Section 1.4.

5. Concrete Water Reservoir Inspection Reports on the structures listed in the schedule herein and provided in Appendix III. Concrete Water Reservoir Inspection Reports were not completed on the West and East Aerator Tanks and Contractor shall assume 1-inch of an Iron/Manganese Sediment for base bids, refer to Contract Documents for the surface area and access for these structures.

1.3 SCHEDULE

A. Society for Protective Coating Report Summary

Tank/Structure	SSPC Concrete Condition	SSPC Rating	Floor Area	Depth of Sediment (IN)	Access Hatch Size (IN)	Vent (Y/N)	Ladder (Y/N)
Washwater Reservoir	B-Bug Holes E-Efflorescence R-Stains	5	45'-0" x 45'-0"	0.25 Iron/Manganese	24x24	Y	Y
Chlorination Chamber	B-Bug Holes C-Cracking E-Efflorescence M-Erosion R-Stains	2	22'-0" x 22'-7"	0.25 Iron/Manganese	24x36	N	N
Clearwell 1A	B-Bug Holes E-Efflorescence R-Stains	2	19'-8" x 79'-8"	0.25 Iron/Manganese	55x49	N	N
Clearwell 1B	B-Bug Holes E-Efflorescence R-Stains	3	18'-4" x 105'-1"	0.5 Iron/Manganese	42x36	N	Y
Clearwell 2A	B-Bug Holes C-Cracking E-Efflorescence R-Stains	5	19'-8" x 129'-0"	0.25 Iron/Manganese	55x48	N	N
Clearwell 2B	B-Bug Holes E-Efflorescence R-Stains S-Spalling	3	18'-4" x 105'-1"	0.25 Iron/Manganese	42x36	N	Y
Clearwell 3A	B-Bug Holes C-Cracking D-Deformation E-Efflorescence M-Erosion R-Stains	3	17'-8" x 34'-8"	0.25 Iron/Manganese	37x30	N	Y
Clearwell 3B	B-Bug Holes E-Efflorescence R-Stains	4	19'-8" x 34'-8"	0.25 Iron/Manganese	30x36	N	Y
High Service Pump Chamber 1	B-Bug Holes C-Cracking E-Efflorescence R-Stains	0	25'-10" x 30'-10"	0.25 Iron/Manganese	24 Dia.	N	N
High Service Pump Chamber 2	B-Bug Holes C-Cracking E-Efflorescence R-Stains	1	25'-10" x 26'-4"	0.25 Iron/Manganese	24 Dia.	N	N

1.4 SAMPLING, TESTING, & REMOVAL IN LANDFILL

A. The Owner/Engineer will make provisions for obtaining samples of removed solids on an hourly or per truck load basis.

B. The Owner/Engineer will provide for laboratory determinations of the Total Suspended Solids (TSS) of the solids at the Owner's Laboratory.

C. Daily dry weight amounts hauled (in tons) will be determined as follows (using that day's gallons hauled and average TSS value):

1. $Dry\ Weight\ in\ Tons = \frac{gallons\ hauled \times Avg.TSS\ (mg/L) \times 8.34}{2{,}000{,}000{,}000}$

2. Or using that day's wet tons of cake hauled:

3. $Dry\ Weight\ in\ Tons = wet\ tons\ \times \frac{Avg.TSS\ (mg/L)}{1{,}000{,}000}$

4. A day shall be considered as beginning at 7:00 A.M. and ending at 7:00 A.M. the following morning.

D. Contractor shall reach an agreement with the Owner/Engineer as to the volume which constitutes a load.

E. The Owner/Engineer will require the Contractor to provide portable scales or other means to determine actual quantities hauled.

F. If required for landfill disposal and if approved by Owner/Engineer, samples of the sludge, solids, and similar debris residuals in the tanks shall be taken and tested by the Contractor at an approved testing facility. The results of these tests will be made available to the Owner prior to the initiation of work.

G. The Contractor is responsible to dewater material enough to meet "paint filter test" as required by landfill.

H. **Removal and Disposal**. In general, it is the intent of this specification to provide for complete removal of the "dewatered in-place" solid materials using contractor furnished equipment, labor, and the hauling of the dewatered solids for proper disposing as described herein. Estimated dry tons per tank/structure are provided herein as applicable. Contractor shall be paid on a unit cost basis as described above. Should the actual value of solids exceed the estimated dry tons stated below and in the Bid Documents, the Contractor shall be paid for removing the excess solids based on the dry ton unit cost basis as established by Contract Documents.

1. Please Note: Prior to exceeding the estimated dry tons provided for each tank and/or structure, the Contractor shall receive approval from Engineer to continue. Removal of any excess solids beyond the established dry tons stated herein (on a structure by structure basis) without approval of the Engineer shall be at no cost to Owner.

1.5 QUALITY ASSURANCE

A. **Codes and Standards.** Perform all work in accordance with current applicable requirements of the governing agencies having jurisdiction. These requirements shall include current OEPA Rules and Occupational Safety & Health Administration confined space entry safety procedures and equipment.

B. **Shutdowns and Draining.** All tank shutdowns and draining required to clean the tanks and/or structures shall be coordinated with the Owner.

1.6 SUBMITTALS

A. **General.** The Contractor shall submit a tank and channel cleaning and disposal work plan to the Engineer for review and comment prior to beginning work. The plan shall describe in detail the means and methods proposed to remove and dispose of the sludge, solids, and similar debris residuals remaining in the tanks after drainage.

B. **Schedule and Data**. The Contractor shall submit to the Engineer a schedule for the removal of solids/sediment from the WTP. The schedule shall provide information on the anticipated hauling dates, volumes, and tons. As the work progresses, the schedule shall be updated to reflect actual data on the volumes removed and disposed.

1.7 JOB CONDITIONS

A. **General.** The Contractor shall have access to all tanks to conduct the solids/sediment and similar debris removal process. Hours of work shall be limited to normal working hours, Monday through Friday, except holidays as defined by the Contract Documents.

B. The Contractor shall plan the work to minimize the impacts of any odor or noise associated with the solids/sediment and similar debris removal operations. The Owner shall make available a potable water connection, and a plant wastewater drain for the return of dewatering recycle flows. **All costs for removing and disposing of the solids/sediment shall be paid as described in the bid forms.**

C. **Site Maintenance.** The Contractor shall be responsible for the clean-up and removal of any solids/sediment and similar debris spilled on the site. The method of such clean-up operations shall be approved by the Owner/ Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. (Not Used)

1.9 SPECIAL WARRANTY

A. (Not Used)

PART 2 PRODUCTS

2.1 (Not Used)

PART 3 EXECUTION

3.1 WORK SCHEDULE AND COORDINATION

A. Review Sequence of Construction Specification 01 14 00, Work Restrictions.

B. The Contractor shall schedule and coordinate all aspects of the solids/sediment and similar debris removal and disposal work. The Contractor shall coordinate the removal of the solids/sediment with the demolition of the existing equipment as shown on Contract Drawings.

3.2 TRANSPORTING AND WEIGHING

A. Meet with the Owner/ Engineer and agree to haul routes prior to beginning work.

B. Provide visible identification for each truck; maintain daily log of truck loading.

C. Provide a portable truck scale system to be used to weigh dewatered solids prior to disposal. Other weighing options may be submitted to the Owner/ Engineer for approval.

3.3 ODOR CONTROL CONTINGENCIES

A. Odor migration from the solids removal, dewatering, storage, and transportation may result in odor complaints. In the event that odor becomes a problem during the operations as determined by the Owner/ Engineer, the Contractor shall take corrective measures to reduce creation and migration of odors off site or off of transport (trucks) using tarps, process changes or other approved methods that mitigate the odors.

3.4 CLEANING UP

A. Clean up all area disturbed by solids removal and disposal operation including haul routes and disposal sites.

B. Remove all equipment and materials from the job site upon completion.

END OF SECTION

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SECTION 02 83 00

ASBESTOS AND LEAD PAINT COLLECTION AND DISPOSAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Contract Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, materials, and supervision necessary to complete the work as specified herein. The Contractor is responsible for the costs and fees for all removal and disposal to complete the work. Refer to Appendix II - Lead and Asbestos Survey Results.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction.

B. **Permits**. Obtain and pay for all permits required to perform the waste material disposal work specified herein.

C. **Safety**. Take all necessary and proper safety precautions when handling the debris in accordance with the Occupational Safety and Health Administration (OSHA) and other state and federal agencies' safety procedures.

1.4 SUBMITTALS

A. General

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Field Test Results

1. Waste material analysis results

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 INSTALLATION

A. Sampling and Laboratory Analysis

1. See Appendix II – Lead and Asbestos Survey Results

B. Collection and Disposal of Nonhazardous Waste Material

1. If, from the laboratory analysis, the waste material is determined to be nonhazardous, collect, store, and dispose of the waste material generated by the surface preparation.

2. See Section 01 74 23, "Cleaning," for more information.

C. Collection of Hazardous Waste Material

1. If, from the laboratory analysis, the waste material from the surfaces samples is hazardous as defined by EPA or other governing agency regulations, collect all debris generated by the blast cleaning operation at the end of each day and store in steel containers having lockable lids.

2. Lock the steel containers and store them inside a secure, lockable trailer at the end of each day.

3. The trailer shall remain on the work site until the disposal method is determined.

D. Disposal of Hazardous Waste Material

1. Hauling, testing, and disposal procedures shall be in accordance with current regulations.

2. Act as the Owner’s agent and arrange and execute the hauling, testing, and disposal of the hazardous waste material.

3. Utilize a firm(s) licensed by the EPA, who shall be responsible for hauling, testing, and ultimate disposal.

4. Provide the Owner with the Uniform Hazardous Waste Manifest (EPA Form 8700-22A), any applications, agreements, contracts, records, and proof of receipt at the disposal site to substantiate the disposal procedures and occurrence.

5. Ensure disposal within 60 days after generation or 14 days from the time permits are received.

6. Disposal shall be within a licensed hazardous waste disposal facility approved by EPA and any other governing authority.

END OF SECTION

SECTION 03 01 73

CONCRETE REPAIR

PART 1 PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, tools, equipment, and materials necessary to repair the spalled, deteriorated, and delaminated areas of existing concrete, concrete joints and necessary cleaning or replacement of reinforcing steel in accordance with the plans and as specified herein.

B. Safety Requirements

1. The Contractor is responsible for providing all shoring required to insure the support, stability and integrity of the overall structure and its individual components.

2. All work is to be done in accordance with all applicable safety standards.

C. Scope of Work

1. Repair of existing exterior and interior concrete walls, floor slabs and stairs as shown on the drawings.
A.

D. Equipment

1. 1.Use maximum 30 pound chipping hammers to remove concrete. The use of jack hammers or hydraulic hoe-ram type hammers will not be permitted at any time on this project.

2. Hydrodemolition is an acceptable alternative method of removing delaminated, deteriorated concrete on the walls and beams only.

3. Use self-contained blasting equipment or equal to mechanically abrade all concrete surfaces to be coated with flexible epoxy coating system.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Comply with provisions of the following codes, specifications, standards and guides except where more stringent requirements are shown or specified:

1. American Concrete Institute (ACI) 546R-96 "Concrete Repair Guide."

2. ICRI Technical Guideline No. 03730, "Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion."

3. ICRI Technical Guideline No. 03733, "Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces."

4. ICRI Technical Guideline No. 03731, “Guide for Selecting Application Methods for the Repair of Concrete Surfaces."

5. ACI 318 "Building Code Requirements for Structural Concrete."

6. 6.ACI 301 "Standard Specification for Structural Concrete."

7. ACI 315 "Details and Detailing of Concrete Reinforcements."

8. Concrete Reinforcing Steel Institute (CRSI) "Reinforcing Bar Detailing."

B. **Experience.** Contractor and equipment manufacturer shall have a minimum of 5 years experience in the successful completion of concrete restoration and repair projects.

1. Installation of flexible epoxy coating system shall be performed by an applicator having satisfactory experience in the application of these or similar materials or with on-site consultation by a qualified field service representative of product manufacturer.

C. **Examination**. Authorized representatives of the Owner shall have access and the right to examine the work under this contract at all times.

D. **Testing**. Materials and installed work may require testing and retesting at any time during progress of work. Testing shall be coordinated and scheduled by the Contractor, but paid for by the Owner.

1. Retesting of rejected materials for installed work, shall be done at Contractor's Expense by a testing firm hired by the Owner.

E. **Job Standard.** Prior to installation of flexible epoxy coating system, the contractor shall install, with the owner’s approval, a mutually agreed upon test sample to show final color and appearance of the system. This test area shall serve as a job standard for the final installation.

1.4 SUBMITTALS

A. **General**. Submit the following in accordance with conditions of contract and Division 1 specification sections.

1. Product data for proprietary materials and items, including reinforcement and forming accessories, bonding compounds, repair mortars, admixtures, patching compounds, waterstops, joint systems, curing compounds, sealers, flexible epoxy coating systems, and others as requested by Engineer.

2. Installation details for flexible epoxy coating system.

3. Concrete mix design.

B. **Materials specified indicate a standard** of quality required on this project. Contractor may submit alternate materials to the Owner for approval. Alternate materials may not be used without approval from the Owner.

C. **Colored Samples.** Prepare and provide samples of colored repair materials in place where patching materials are placed on wall surfaces exposed to view that do not receive an additional surface coating. Adjust manufacturer recommended coloring agents to simulate existing surface color. Owner, contractor, and manufacturer shall review and mutually agree upon color, grade, and final texture

of flexible epoxy coating system before starting installation. The acceptance of a sample will constitute the job standard by which installation will proceed.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE AND HANDLING

A. **Manufacturer's recommendations shall be followed** in the delivery, storage and handling of all materials.

B. Store materials only in areas approved by the Owner.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. General

1. The types of repair materials shall be as noted below for each specific repair condition.

B. Reinforcement

1. Welded wire fabric shall conform to American Society for Testing and Materials (ASTM) A 185.

2. Deformed reinforcing bars shall conform to ASTM A 615, Grade 60.

3. All reinforcement shall be epoxy-coated per ASTM A 775.

a. Provide epoxy touch-up paint of a different color to coat nicks, cuts, and ends of bars in field.

b. Use plastic or epoxy-coated bar supports and tie wire to prevent electrical coupling between bars.

C. Bonding Agent/Corrosion Protection

1. Corr-Bond bonding agent. Euclid Chemical Company.

2. MasterEmaco P 124 bonding agent. Master Builders Technologies.

3. Sika Armatec 110 bonding agent. Sika Corporation.

D. Vertical Surface Patch Repair Mortar

1. Verticoat Supreme, microsilica and latex modified one component nonsag repair mortar. Euclid Chemical Company.

2. MasterEmaco S 488 CI repairs mortar. Master Builders Technologies.

3. SikaTop 123 Plus, a two-component polymer-modified mortar for repairs from 1/8" to 1-1/2" with greater depths using 1-1/2" lifts. Sika Corporation.

E. Horizontal Surface Patch Repair Mortar

1. Eucocrete repair mortar. Euclid Chemical Company.

2. 2.MasterEmaco T430 rapid strength repair mortar. Master Builders Technologies.

3. SikaTop 122 Plus, polymer modified two component kit for repairs greater than 1/2 inch, but less than 7 inches. Sika Corporation.

F. Curing

1. Curing materials and methods shall be in strict accordance with manufacturer's recommendations for the specific materials used.

2. Wet cure horizontal repairs for a minimum of 7 days.

G. **Flexible Epoxy Coating System** components listed below are by Tnemec Company, Inc./Ohio Coating Consultants (1-800-890-7580). Equal system may be used with engineer approval.

1. Primer: Series 201 Epoxoprime, multipurpose penetrating polyamine cured epoxy primer.

2. Flexible Membrane: Series 206 Sub-Flex EP flexible epoxy.

3. Topcoat: Series 291 Endura-Shield, chemical resistant urethane finish.

H. Crack and Joint Sealant

1. Euclid Chemical Company.

a. Primer. Eucolastic/NEO Seal Primer.

b. Sealant. Eucloastic.

2. Sika Corporation.

a. Primer. Sikaprime 429.

b. Sealant. Sikaflex 2c SL.

3. Sonneborn.

a. Primer. Primer 733.

b. Sealant. NP1 or NP2.

PART 3 EXECUTION

3.1 CONCRETE PREPARATION

A. **In areas to be patched or poured** to a new surface, all loose, delaminated and disintegrated concrete, dirt, debris, impregnations, foreign materials, etc., shall be removed and the areas thoroughly cleaned by approved methods.

1. The Contractor shall determine the location and extent of the repair areas. The surfaces shall be sounded by tapping with a rod, hammer, or chain drag method in the presence of the Owner. All unsound areas shall be marked by the contractor and removed as approved by the Owner.

2. Saw-cut edges of repairs a minimum of 1 inch deep. Take special precautions not to cut or nick existing reinforcement. Provide square or rectangular areas of repair. Sound concrete is to be removed within the saw-cut areas as necessary.

3. Removal shall be done by hand-chipping, water-blasting, or other method that will accomplish the work in a manner that will not damage or shatter the concrete that is to remain. Fine particles shall be removed by air and water operated at not less than 50 psi. Care shall be used in working around the existing reinforcing steel so as to not contact the steel directly with a pneumatic hammer or hand tool, which may cut the

steel or shatter the concrete around and beyond the repair area. See Reinforcement Preparation below.

B. **Areas of existing concrete to be coated with Flexible Epoxy Coating System** shall be mechanically abraded by means of self-contained blasting equipment or equal to remove all laitance and surface contaminants and provide a minimum profile similar to 40-60 grit sandpaper (Reference ASTM D 4259, ICRI CSP 3-5). After mechanically abrading, verify that all surfaces are clean, dry, and free of any contaminants which could adversely affect the adhesion of the flooring system.

C. **Off-site disposal of all materials removed** shall be the responsibility of the Contractor.

3.2 REINFORCEMENT PREPARATION

A. **Rusted reinforcing bars** and mesh exposed by the removal of spalled, delaminated, or unsound concrete shall have sufficient sound concrete removed to a minimum of 3/4 inch around the bar.

B. **The total surface of exposed** reinforcing steel shall be cleaned of all rust and scale. Measure the average diameter of each piece of exposed reinforcing at its thinnest point. Where the area of steel remaining is less than 85 percent of its original nominal area, splice in new reinforcing. The size and length of the new reinforcing will be determined by the Owner, and will be based on the area of reinforcing remaining and on other factors.

3.3 SUBSTRATE ACCEPTANCE

A. **After all deteriorated concrete has been removed** down to a sound substrate, all surfaces shall be inspected by the Owner or the authorized representative of the Owner for soundness. Subsequent areas identified as not being sound shall be removed. Approval by the Owner is required prior to the application of any repair materials.

B. **Any repair material which is placed** by the Contractor without acceptance of the substrate by the Owner, or the authorized representative of the Owner, will be removed and replaced by the Contractor at no additional cost to the Owner.

3.4 TEMPERATURE

A. **Hot and cold weather placement of concrete** shall be in accordance with ACI 305 and ACI 306.

B. **Consult the manufacturer for mixing**, placing, and curing procedures of repair mortars when the ambient temperature is below 50 degrees Fahrenheit (° F.) or above 85° F.

C. **Any day during which the curing temperature** falls below 45° F. shall not be counted as a curing day. If, at any time during the curing period, the curing temperature falls below 35° F. the work will be rejected and removed and replaced.

D. **For flexible epoxy coating system**, surface and surrounding air temperatures must exceed 55° F but must be less than 90° F with materials at not less than 55° F during application.

3.5 GENERAL PATCHING PRECAUTIONS

A. **A technical representative of each material supplier** shall review and approve the procedures prior to the use of their materials.

B. **Presaturate all surfaces to be patched** as specified by the manufacturer's instructions.

C. **For patches thicker than** 1-1/2 inches add 3/8-inch washed pea gravel.

D. **Do not install patches** within 90 feet of any area where concrete is being removed.

E. **Protect all patches from premature drying** and excessively hot or cold weather for the necessary period for the proper setting of the patch. Cure the patch per manufacturer's recommendations or for seven days, maintaining a temperature of 50° F. or more.

F. **Protect patches against rain and inclement weather** with tarpaulins or similar waterproof protection until the patch has set.

3.6 VERTICAL/HORIZONTAL SURFACE PATCH REPAIR

A. **Follow concrete and reinforcement preparation** as described herein.

B. **Apply bonding agent to substrate** and exposed reinforcement. Alternatively, substrate may be coated with a scrub coat of patching material immediately prior to application of patching material.

C. **Mixing and placing of repair mortars** shall be in accordance with manufacturer's instructions.

D. Finish surfaces to match existing.

E. **Properly cure and seal all repairs** per manufacturer's recommendations.

3.7 CRACK REPAIR

A. **Identify** concrete crack locations.

B. **Prepare surface** per manufacturer's recommendations.

C. **Rout or saw-cut crack** to 1/4-inch by 1/4-inch minimum configuration.

D. **Blow clean joint** with oil-free compressed air and mechanically clean crack surface per manufacturer's recommendations.

E. **Mix and place repair materials** in accordance with the manufacturer's instructions.

F. **Properly cure all repair materials** per manufacturer's recommendations.

3.8 ACCEPTANCE

A. The Owner or the authorized representative of the Owner shall review all areas and items repaired. Any work found to be defective or unsatisfactory shall be removed and replaced at no additional cost to the Owner.

3.9 CLEANUP

A. Remove all waste materials, rubbish, and debris and dispose of them at the owner's discretion.

3.10 PROTECTION

A. Protect the completed flexible epoxy coating system from water, airborne particles or other surface contaminants until cured for 24 hours. Protect from traffic, physical abuse, immersion and chemical exposure until the complete system has thoroughly cured for the minimum equivalent of 24 hours at 75°F. For different temperatures, consult the manufacturer's representative about curing times.

END OF SECTION

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Furnish and install the cast-in-place concrete in accordance with the drawings and as specified herein.

1. This section specifies cast-in-place concrete, including formwork, reinforcing, mix design, accessories, placement procedures, joints, finishes, curing, supports for equipment and piping, and grout toppings for tanks.

2. Other specification sections may reference this section for other cast-in-place concrete items.

3. Install embedded items required for material and equipment specified in other divisions of these specifications.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Comply with the provisions of the following standards:

1. ACI – American Concrete Institute.

2. ASTM – American Society for Testing and Materials.

3. CRSI – Concrete Reinforcing Steel Institute.

4. AASHTO – American Association of State Highway and Transportation Officials.

5. AWWA – American Water Works Association.

C. **Concrete Testing Service**. The Owner will engage acceptable laboratory to perform material evaluation tests and to design concrete mixes at the Owner's expense. The Contractor shall coordinate and schedule all testing services.

D. **Testing**. Materials and installed work may require testing and retesting at any time during progress of work. Retesting of rejected materials or installed work shall be done at Contractor's expense.

E. **Concrete Conference**. Conduct conference at project site to comply with the following:

1. Prior to submittal of design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials.

Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Request that representatives of each entity directly concerned with cast-in-place concrete attend conference, including, but not limited to, the following:

a. Contractor's superintendent.

b. Laboratory responsible for concrete mix design.

c. Laboratory responsible for field quality control.

d. Ready-Mix concrete supplier.

e. Concrete subcontractor.

f. Primary admixture manufacturers.

g. Engineer/Architect or Owner's Representative.

2. Concrete conference may be waived by the Engineer/Architect or Owner's Representative.

1.4 SUBMITTALS

A. General

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Shop Drawings and Product Data

1. Product Data. Submit product data for materials and items, such as cement, reinforcement, embedded forming accessories, admixtures, patching compounds, waterstops, joint systems, and curing compounds.

2. Shop Drawings and Submittals.

a. Reinforcement. Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66 (88), "ACI Detailing Manual," showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures, and dowel reinforcement for masonry.

b. Concrete Mix Designs. Submit concrete mix designs for each class of concrete to be used on the project including specifics regarding admixtures proposed for each mix design. Include concrete test reports to substantiate trial batch mixes or previous performance of the same mix design.

c. Materials Certificates. Submit materials certificates with the concrete mix design. Materials certificates shall be signed by manufacturer certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

d. Construction Joint Locations. Submit details which clearly show where construction joints are intended to be placed in walls, slabs, columns, beams, at stairwells, etc.

e. Box Outs. Submit proposed locations of box outs.

3. Testing Laboratories. Submit the names of the testing laboratories proposed for use to perform the material evaluation tests and also to perform the field quality control testing. An ACI certified technician shall perform all concrete testing.

C. Submittal Package No. 2 – Batch Tickets

1. Batch Tickets. Submit batch tickets for each load of concrete used on the job. Each ticket shall indicate the design mix, the project name, the date, the time of batching, and the truck number.

D. Submittal Package No. 3 – Test Reports

1. Concrete Test Reports. Submit two copies of all concrete test reports from the concrete testing laboratory directly to the Engineer/Architect.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate installation of joint materials, embedded items, vapor retarders, etc., with placement of forms and reinforcing steel. Coordinate concrete work with all other trades to prevent delays, errors, or omissions.

B. **Reference Material**. Provide a copy of ACI SP-15, Field Reference Manual, in the field office at all times during concrete construction.

C. **Climatic Conditions**. Perform placement and curing of concrete under various weather conditions in accordance with ACI 301, "Specifications for Structural Concrete for Buildings," ACI 305, "Hot Weather Concreting," and ACI 306, "Cold Weather Concreting," except as modified herein.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, and Placing Concrete."

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. Forms

1. Exposed finish concrete forms shall be plywood, metal, metal framed plywood faced, or other acceptable panel type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown.

2. Unexposed finish concrete forms shall be plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

3. Cylindrical column and support forms shall be metal, fiberglass reinforced plastic, or paper or fiber tubes.

a. When used, provide paper or fiber tubes of laminated plies with water resistant adhesive and wax impregnated exterior for weather and moisture protection.

b. Provide sufficient wall thickness to resist wet concrete loads without deformation.

B. **Form coatings.** Commercial formulation form coating compounds with a maximum volatile organic compound (VOC) of 350 milligrams per liter (mg/l) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

C. **Form ties.** Factory-fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal.

1. Provide units that will leave no metal closer than 1 inch to exposed surface.

2. Provide ties that, when removed, will leave holes not larger than 1 1/2 inch diameter in concrete surface.

D. Reinforcing Materials

1. Reinforcing Bars. ASTM A 615, A 616, including Supplemental Requirement S1, or A 617; Grade 60, deformed.

2. Epoxy Coated Reinforcing Bars. ASTM A 775.

3. Welded Wire Fabric. ASTM A 185, welded steel wire fabric, provided in flat sheets.

4. Supports for Reinforcement. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use steel bar supports or precast concrete bar supports complying with CRSI specifications.

a. For slabs on grade, use steel bar supports with sand plates or horizontal runners or precast concrete bar supports where base material will not support chair legs.

b. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel (CRSI, Class 2).

E. Concrete Materials

1. Portland Cement. ASTM C 150, Type I or Type II in areas where alkali-aggregate reaction is a problem. Use one brand of cement throughout project.

2. Fly Ash. ASTM C 618, Type C or Type F including supplementary optional physical requirements, except loss on ignition shall not exceed 3 percent.

3. Normal Weight Aggregates. ASTM C 33 and as herein specified.

a. For exposed concrete, provide aggregates from a single source.

b. For exterior exposed surfaces, do not use fine or coarse aggregates containing deleterious substances which might cause spalling.

c. Fine Aggregate. Fine aggregate shall consist of natural sand or manufactured sand.

d. Coarse Aggregate. Coarse aggregate shall consist of crushed rock, gravel, or crushed gravel.

1) Grading. The coarse aggregate shall conform to requirements for Size 57, unless otherwise approved.

2) Deleterious substances shall not exceed the percentages for Class 4S.

4. Water. Potable.

5. Admixtures. Provide admixtures that contain a maximum of 0.05 percent chloride ions by weight of cement when tested in accordance with AASHTO T260. Certificate from admixture manufacturer will be required prior to mix design approval.

a. Air-Entraining Admixture.

1) ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Darex II or Daravair, GCP Applied Technologies

b) MasterAir VR 10 or MasterAir AE 200, Master Builders, Inc.

c) Sika AER, Sika Corp.

d) AEA-92 or Air Mix 200, Euclid Chemical Co.

b. Water-Reducing Admixture.

1) ASTM C 494, Type A.

2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Eucon WR-75 or WR-89, Euclid Chemical Co.

b) WRDA with Hycol, GCP Applied Technologies

c) Daracem-55, GCP Applied Technologies

d) MasterPozzolith 220, MasterPozzolith 322, or MasterPolyheed, Master Builders, Inc.

e) Plastocrete 161, Sika Corp.

c. High-Range Water-Reducing (HRWR) Admixture (Super Plasticizer).

1) ASTM C 494, Type F or Type G.

2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Eucon 37, Euclid Chemical Co.

b) Daracem 19, Daracem ML330, or Daracem ML500, GCP Applied Technologies

c) MasterRheobuild, Master Builders, Inc.

d) Sikament, Sika Corp.

d. Noncorrosive, Nonchloride Accelerating Admixture.

1) ASTM C 494, Type C or E.

2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Accelguard 80, Euclid Chemical Co.

b) Polarset, GCP Applied Technologies

c) MasterSet FP 20, Master Builders, Inc.

e. Water-Reducing, Retarding Admixture.

1) ASTM C 494, Type D.

2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Eucon Retarder 75, Euclid Chemical Co.

b) Daratard-17, GCP Applied Technologies

c) MasterPozzolith, Master Builders, Inc.

d) Plastiment, Sika Corporation.

f. Crystalline Waterproofing Admixture. Subject to compliance with requirements, products that may be incorporated in the work include the following:

1) Penetron ADMIX.

2) Aquafin-IC.

3) Kryton KIM.

4) Xypex ADMX C-Series.

5) BASF Masterlife 300D.

2.2 ACCESSORIES

A. **Reglets**. Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217-inch-thick (26-gauge) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Polyvinyl (PVC) Chloride Waterstops. Corps of Engineers CRD-C 572.

1. Waterstops for construction joints shall be serrated type without center bulb and at least 3/8 inch thick and 6 inches wide.

2. Waterstop for expansion joints shall be serrated type with center bulb and at least 3/8 inch thick and 9 inches wide.

3. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

    a. Greenstreak Plastic Products Co.

    b. DuraJoint.

    c. BoMetals, Inc.

C. Bitumen Waterstops

1. Provide a single component self-sealing plastic adhesive type waterstop which is nonoxidizing, nonevaporating, nonexpanding, non-shrinking, and resistant to water, chemicals, and saturated hydrogen sulfide.

2. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

    a. Synko-Flex, Synko-Flex Products.

    b. Seal-Tite, DuraJoint.

D. **Sand Cushion**. Clean, manufactured or natural sand conforming to ASTM C 33 or C 144.

E. **Vapor Retarder.** ASTM E 1745 Class A Compliant with a permeance of 0.01 before and after mandatory conditioning as required by (ASTM E 1745 Section 7.1 and Sub-paragraphs 7.1.1 – 7.1.5).

1. Provide vapor retarder cover over prepared base material where indicated below slabs on grade.

2. Subject to compliance with these specifications, the vapor retarder may be one of the following:

    a. Stego Wrap 15 mil by Stego Industries, LLC

    b. Vapor Flex by Layfield

    c. Moistop Ultra 15 by Fortifiber Industries

F. **Chemical Hardener.** Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 pounds of fluosilicates per gallon.

1. Use hardener on existing concrete where noted.

2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. Surfhard, Euclid Chemical Co.

    b. Lapidolith, Sonneborn

    c. Fluohard, L&M Construction Chemical, Inc.

G. Sealer/Dustproofer

1. Floor hardener compound for new concrete shall be an acrylic containing not less than 14 percent solids.

2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

   a. Super Diamond Clear VOX, Euclid Chemical Company.

   b. Dress and Seal WB30, L&M Construction Chemicals, Inc.

H. **Absorptive Cover**. Burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard, complying with AASHTO M 182, Class 2.

I. **Moisture-Retaining Cover**. One of the following complying with ASTM C 171.

1. Waterproof paper.

2. Polyethylene film.

3. Polyethylene coated burlap.

J. **Curing Compound.** Clear styrene acrylate type, 30 percent solids content minimum.

1. Submit test data from an independent testing laboratory indicating a maximum moisture loss of 0.55 kilograms (kg) per square meter when applied at a coverage rate of 200 square feet per gallon.

2. Verify compatibility of curing compound with finishes to be used.

3. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

   a. Super Diamond Clear VOX, Euclid Chemical Company.

   b. Dress and Seal WB30, L&M Construction Chemicals, Inc.

K. Evaporation-Control Compound

1. Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

   a. Aquafilm, Dayton Superior

   b. Eucobar, Euclid Chemical Co.

   c. E-Con, L&M Construction Chemicals, Inc.

   d. MasterKure ER 50, Master Builders, Inc.

L. Bonding Compound

1. Polyvinyl acetate or acrylic base.

2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Polyvinyl Acetate (Interior Only). Appropriate product by:

1) Dayton Superior Corp.

2) Euclid Chemical Co.

3) Larsen Products Corp.

4) L&M Construction Chemicals, Inc.

b. Acrylic or Styrene Butadiene. Appropriate product by:

1) Euclid Chemical Co.

2) GCP Applied Technologies

3) Master Builders, Inc.

4) Stonhard, Inc.

M. Epoxy Adhesive

1. ASTM C 881, two-component material suitable for use on dry or damp surfaces.

2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Sikadur 32 Hi-Mod, Sika Corp.

b. Euco Epoxy System #452 or #620, Euclid Chemical Co.

c. Epobond, L&M Construction Chemicals, Inc.

N. **Expansion Joint and Isolation Joint Material**. Use one of the following unless noted otherwise.

1. Self-expanding cork conforming to ASTM D 1752, Type III.

2. Cellular fiber-asphalt conforming to ASTM D 1751.

3. Neoprene/SBR polymer conforming to ASTM D 1056-67.

2.3 MIXES

A. General

1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

2. If trial batch method used, retain an acceptable independent testing facility for preparing and reporting proposed mix designs.

3. The testing facility shall not be the same as used for field quality control testing.

4. Submit mix designs of each proposed mix for each class of concrete at least 15 days prior to start of work.

5. Do not begin concrete production until proposed mix designs have been reviewed.

6. Limit use of fly ash not to exceed 25 percent of cement content by weight.

a. In areas where alkali aggregate reaction is a problem, do not add less than 20 percent fly ash by weight.

b. When used, fly ash shall replace cement at a 1:1 ratio for Class C fly ash and a 1.25:1 ratio for Class F fly ash (Class F fly ash to cement).

c. Adjust weights of concrete materials to provide the correct yield.

B. **Design Mixes**. Provide normal weight concrete with the following properties, unless otherwise indicated. Tolerance for air content shall be ±1 percent.

1. Class A. 4,000 pounds per square inch (psi), 28-day compressive strength.

a. Water/Cementitious Product (w/c) ratio, 0.45 maximum; minimum cementitious material, 541 pounds per cubic yard (cy).

b. 6 percent air.

2. Class B. 3,000 psi, 28-day compressive strength.

a. w/c ratio, 0.50 maximum; minimum cementitious material, 541 pounds per cy.

b. 6 percent air.

3. Class C. 2,000 psi, 28-day compressive strength.

a. w/c ratio, 0.6 maximum; minimum cementitious material, 376 pounds per cy.

b. 6 percent air.

4. Class D.

a. w/c ratio, 0.45 maximum; minimum cementitious material, 846 pounds per cy.

b. Fine aggregate to cement ratio shall not exceed 3.0 by weight.

c. 6 percent air.

5. Class S. 4,500 psi, 28-day compressive strength.

a. w/c ratio, 0.42 maximum; minimum cementitious material, 564 pounds per cy.

b. 6 percent air.

6. Class W. In accordance with Class S, except:

a. Contains crystalline waterproofing admixture in accordance with paragraph 2.1.E.5.f.

b. Dose in accordance with admixture manufacturer's recommendations.

C. **Slump Limits**. Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps and sloping surfaces. Less than 3 inches.

2. Reinforced foundation systems. 2 to 4 inches.

3. Concrete containing HRWR admixture (Superplasticizer). Less than 8 inches after addition of HRWR to site verified 2-inch to 3-inch slump concrete without HRWR.

4. Other concrete. Less than 4 inches for slabs and less than 5 inches for walls, curbs, bases, and other miscellaneous concrete.

D. **Chloride Content**. The maximum water-soluble chloride ion content, expressed as a percent by weight of cement contributed by all ingredients of the concrete mix shall not exceed 0.10 percent.

E. **Controlled Density Fill or Controlled Low-Strength Material**. The fine aggregates shall be fine enough to stay in suspension in the mixture to the extent required for proper flow. Provide with the following properties, unless otherwise indicated:

1. 100 psi, 28-day compressive strength.

   a. Cement, 100 pounds.

   b. Fly Ash, 250 pounds.

   c. Fine Aggregate, Saturated Surface Dry, 2,800 pounds.

   d. Water, 500 pounds maximum.

2. It is necessary for bleed water to appear on the surface immediately after the fill is struck off.

   a. A delay in bleeding indicates there are too many fines in the mixture, so reduce the fly ash quantity in increments of 50 pounds until mixture is bleeding freely.

   b. Add approximately 60 pounds of sand to replace each 50-pound increment of fly ash to maintain the original yield.

F. **Dry Pack Mortar**. Mix dry pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

G. **Cement Mortar**. A mixture of sand, cement, and water in the same proportions used for the concrete being placed, but omit all coarse aggregate.

H. **Adjustment to Concrete and Mixes**. Request mix design adjustments when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as approved. Submit laboratory test data for revised mix design and strength results for acceptance before using in work.

I. **Admixtures**. Use of Admixtures.

1. Use water-reducing admixture for placement and workability in all classes of concrete unless noted otherwise.

2. A noncorrosive nonchloride accelerating admixture may be used in concrete slabs placed at ambient temperatures below 50 degrees Fahrenheit (° F.) when approved.

3. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content as indicated in the design mix.

J. **Concrete Mixing.** Ready Mix Concrete. Comply with requirements of ASTM C 94 and as specified.

1. When air temperature is between 85° F. and 90° F., mixing and delivery time shall not exceed 75 minutes.

2. When air temperature is above 90° F., mixing and delivery time shall not exceed 60 minutes unless approved otherwise.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Tolerances**. Unless otherwise specified, tolerances shall be in accordance with ACI 117 and ACI 301.

B. **Inspection**. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work. Verify that all wood, dirt, foreign objects, and all other debris have been removed from inside the formwork. Verify that reinforcing steel is spaced to provide the proper coverage against forms and against earth for slabs on grade. When requested, provide documentation of inspection prior to placing concrete.

C. **Site and Weather Conditions**. Do not place concrete when site conditions exist such as standing water, extreme heat or cold, etc., unless the proper precautions have been taken to properly place and protect concrete as recommended by ACI and as acceptable. Do not place concrete on frozen ground.

3.2 PREPARATION

A. Forms

1. General. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Maintain formwork construction tolerances complying with ACI 347.

2. Forms. Construct forms to sizes, shapes, lines, position, elevation, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

3. Fabrication of Forms. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

4. Openings. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and

set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

5. Exposed Corners and Edges. Chamfer exposed corners and edges using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

6. Provisions for Other Trades. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

7. Cleaning and Tightening. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

8. Form Coatings. Coat contact surfaces of forms with an approved, nonresidual, low VOC, form coating compound before reinforcement is placed.

   a. Do not allow excess form coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

   b. Coat steel forms with a nonstaining, rust preventative material. Rust stained steel formwork is not acceptable.

   c. Form coatings for use in water treatment plants shall be nontoxic after 30 days from the date the forms are removed.

B. Reuse of Forms

1. Clean and repair surfaces of all forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

2. Successive Reuse. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces except as acceptable.

3.3 INSTALLATION

A. Vapor Retarder Installation

1. General. Install vapor retarder where shown on drawings per ASTM E/643-10. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.

2. Lapping. Lap joints 6 inches and seal vapor barrier joints with manufacturer's recommended mastic and pressure sensitive tape.

3. Protection. After placement of vapor retarder, cover with sand cushion, dampen and compact to 100 percent as determined by ASTM D 698 to the depth as shown on drawings. Sand shall be free of self-draining water when concrete is placed.

B. Placing Reinforcement

1. General. Comply with CRSI's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as herein specified.

a. Avoiding cutting or puncturing vapor retarder barrier during reinforcement placement and concreting operations.

2. Cleaning. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

3. Installation.

a. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved.

b. Place reinforcement to obtain at least minimum coverages for concrete protection as noted in ACI 301. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

c. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh plus 2 inches or 8 inches and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

C. Joints

1. Construction Joints. Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable.

a. Provide keyways 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Accepted bulkheads designed for this purpose may be used for slabs.

b. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated.

c. The maximum length of wall pours shall not exceed 40 feet, and slab pours shall not exceed 40 feet in length or width.

d. Bond fresh concrete to hardened new concrete as follows:

1) For horizontal joints, place new concrete on a 1-inch layer of cement mortar evenly spread over the previously placed concrete. Thoroughly clean and remove laitance of previously placed concrete.

2) For vertical joints, thoroughly clean the surface of the hardened concrete and remove all laitance prior to placing new concrete.

e. If noted on the drawings, prior to placement of new concrete against old existing concrete, apply bonding agent to surface of old concrete, if accessible, immediately before placement of new concrete.

f. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops in accordance with manufacturer's printed instructions. Provide continuous waterstops in construction joints as follows:

1) Liquid-bearing walls and slabs.

2) Walls or slabs subject to groundwater and/or in contact with ground.

3) Elsewhere as indicated.

2. Isolation Joints in Slabs-on-Ground. Construct isolation joints as indicated in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as shown. Fill joints where noted with sealant specified in other sections of these specifications.

3. Contraction (Control) Joints in Slabs-on-Ground. Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8 inch wide by 1/4 slab depth, unless otherwise indicated. In lieu of saw cutting and with, the Contractor may form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

a. Saw-cut as soon as possible after slab finishing without dislodging aggregate.

b. If joint pattern not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

c. Provide joint, filler, and sealant materials where shown.

4. Control Joints in Retaining Wall. Provide control joints at 32 feet on center maximum unless otherwise shown. Provide 1-1/2 inch deep by 1/3 wall thickness vertical keyway. Horizontal reinforcing shall not pass through joint. Joints need not be provided in retaining wall footings.

5. Expansion Joints. Construct expansion joints where shown. If not shown, provide expansion joints at interval not to exceed the following:

a. Retaining Walls. 96 feet (not required in footings).

6. Waterstop. Provide waterstops in all joints shown on the drawings and as listed in this specification.

a. Provide PVC waterstops in all joints unless noted or specified otherwise.

b. Properly support and wire all waterstops to reinforcing to remain straight and true. Heat-splice all joints per manufacturer's recommendations.

c. Provide bitumen waterstop in joint between new and existing concrete.

D. Installation of Embedded Items

1. Set and build into the work, anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by other prime Contractors and suppliers of items to be attached thereto.

2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

3. Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting type screeds.

E. Concrete Placement

1. Location. Provide concrete as specified in the table below unless otherwise indicated on the drawings.

Location	**Design Mix**
All reinforced concrete and nonreinforced fillets	4,500 psi Class S
Nonreinforced concrete not designated as Class A, C, or D	3,000 psi Class B
Nonreinforced so designated on plans	2,000 psi Class C
Grout fill or topping as designated on plans	Class D

2. General. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

a. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness, or to be resistant to the penetration of a vibrator. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.

3. Placing Concrete in Forms. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

    a. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

    b. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete around reinforcement and other embedded items without causing segregation of mix.

4. Placing Concrete Slabs. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

    a. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. When epoxy coated reinforced steel is used, vibrators shall have nonmetallic heads.

    b. Bring slab surfaces to correct level with straightedge and strike off. Use highway straightedge, bull floats, darbies, or other means to obtain a smooth surface which is free of humps or hollows and that conforms to the required flatness and levelness. Do not disturb slab surfaces prior to beginning finishing operations.

    c. Maintain reinforcing in proper position during concrete placement.

5. Cold Weather Placing. Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

    a. When air temperature has fallen to or is expected to fall below 40° F. (4° C.), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50° F. (10° C.) and not more than 80° F. (27° C.) at point of placement.

    b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

    c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

6. Hot Weather Placing. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

   a. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90° F. (32° C.). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

   b. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

   c. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.

   d. Use water reducing retarding admixture when required by high temperatures or other adverse placing conditions, when acceptable to Engineer/Architect.

   e. Use evaporation control compound in accordance with manufacturer's recommendations or fogging.

7. Adjusting Concrete Slump at Job Site.

   a. Slump Greater than Specified. Do not use concrete with slump greater than specified.

   b. Slump Less than Specified. If on arrival at the job site, the slump of the concrete is less than specified, the following remedies may be used at the Contractor's option.

      1) Add water only if the maximum specified w/c ratio is not exceeded.

      2) Additional water shall be accompanied by a quantity of cement sufficient to maintain the specified w/c ratio.

      3) Add an approved water reducing admixture.

F. Controlled Density Fill Placement

1. General. Unless noted otherwise, place controlled density fill in overexcavated areas under slabs, in utility trenches within roadways, and as directed by the Engineer/Architect.

2. Mixing Equipment. Sufficient mixing capacity of mixers shall be provided to permit the fill to be placed without interruption.

3. Placing Fill. Flowable fill shall be discharged from the mixer by any reasonable means into the space to be filled. The fill material shall be brought up uniformly to the fill line shown on the plans or as directed. Placing of any material over low strength fill may commence as soon as the surface water is gone or as directed.

G. **Finish of Formed Surfaces.** Inside face of covered basins, clear wells and reservoirs, filters below the media line, open tanks and flumes below water or

flow lines, and the outside of structures below finish grade lines shall be classified as not exposed to view.

1. Finish. Finish formed concrete surfaces in accordance with the schedule below.

Location	Type of Finish
Concrete surfaces not exposed to view or surfaces to be covered with a coating material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or other similar system	Smooth form finish
Concrete exposed to view including surfaces which will be painted	Smooth rubbed finish or grout-cleaned finish

2. Smooth Form Finish. This is an as-cast concrete surface obtained with selected form facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

3. Smooth Rubbed Finish. Provide smooth-rubbed finish not later than 1 day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

4. Grout-Cleaned Finish. Mix one part portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout with the consistency of thick paint. Substitute white portland cement for a part of the gray portland cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with brushes or a spray gun. Immediately after applying the grout, scrub the surface with a cork float or stone to coat the surface and fill all air bubbles and holes. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, burlap, or other means. After the surface whitens from drying, rub with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.

5. Related Unformed Surfaces. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

H. Slab Finishes

1. Finish. Finish slab surfaces in accordance with the schedule below unless finish is specifically noted on the drawings:

Location	**Type of Finish**
Slabs to receive grout topping	Rough finish
Slabs to receive concrete topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated	Scratch finish
Slabs to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated	Float finish
Slabs of tanks, flumes, channels, wet wells, etc., which are submerged including grout toppings	Trowel finish after float finishing
Slabs to be exposed to view or covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system	Trowel finish after float finishing
Slabs to be covered with ceramic quarry tile installed with thin set mortar	Float finish followed by trowel and fine broom finish
Exterior concrete platforms, steps, ramps, and elsewhere as indicated	Float finish followed by nonslip broom finish

2. Floor Levelness, General. Floor levelness requirements below do not apply to sloped slabs or unshored slabs on metal deck.

3. Scratch Finish. After placing slabs, plane surface to tolerances for floor flatness (Ff) of 20 and floor levelness (Fl) of 17. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

4. Float Finish. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power driven floats, or both. Consolidate surface with power driven floats or by hand floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of Ff 25 - Fl 20. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

5. Trowel Finish. After floating, begin first trowel finish operation using a power driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 50 - Fl 35. Grind smooth surface defects that would telegraph through applied floor covering system.

6. Trowel and Fine Broom Finish. Apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

7. Nonslip Broom Finish. Immediately after float finishing, slightly roughen concrete surface by brooming with stiff fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer/Architect before application.

8. Rough Finish. The bottom of concrete tanks which are to receive grout topping shall receive a rough finish for maximum adhesion. The surface to receive the grout topping shall be intentionally roughened to a minimum amplitude of 1/4 inch.

9. Chemical Hardener Finish. Apply chemical hardener finish to existing interior concrete floors where indicated. Clean floors and allow to dry before applying hardener.

    a. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.

    b. After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

10. Sealer/Dustproofer Finish. All exposed surfaces and floors within buildings which will be subject to pedestrian or vehicular traffic under normal operation, shall be treated to seal and dustproof the surface. This shall be accomplished by the use of a liquid sealer/dustproofer applied in three applications in accordance with the manufacturer's directions. Application of the sealer/dustproofer shall be performed as late as possible and just prior to completion of construction.

I. **Placing Grout Toppings**. Grout toppings shall be Class D concrete mix design unless noted otherwise.

1. Procedure.

    a. Prior to placement of the structurally bonded topping, remove all laitance, debris, and loose and foreign material from the base slab. Use water-blasting, sandblasting, or other methods acceptable to the Engineer/Architect.

    b. Thoroughly wet the base slab before placing the grout topping. Remove all standing water from the surface prior to placing neat cement grout.

    c. Brush in neat cement grout as a bonding agent immediately before application of grout topping. Do not allow neat cement grout to set prior to placing grout topping.

    d. Where recommended by manufacturer, use the tank mechanism to screed the grout on the tank floor as it is placed. Screed in accordance with the manufacturer's instructions.

    e. Trowel finish topping as specified above.

    f. Moisture cure grout toppings as specified herein.

J. Miscellaneous Concrete Items

1. Filling In. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

2. Equipment Bases and Foundations. Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.4 CONCRETE SURFACE REPAIRS

A. **Patching Defective Areas**. Repair and patch defective areas and plug form tie holes with cement mortar immediately after removal of forms, when acceptable to Engineer/Architect.

1. Cut out honeycomb, rock pockets, and voids over 1/4 inch in any dimension down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with specified bonding compound. Place patching mortar before bonding compound has dried.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface. After shrinkage has occurred, grind surface until flush.

B. **Repair of Formed Surfaces**. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer/Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.

C. **Repair of Unformed Surfaces**. Repair or replace supported slabs that fail to meet the specified finish requirements. Correct levelness and flatness, and low and high areas as herein specified. For slabs on grade, remove slab between control joints and replace with concrete slab meeting floor finish and tolerances. For all other unformed surfaces, repair as follows:

1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into

adjacent concrete. Underlayment compounds may be used when acceptable.

4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

D. **Miscellaneous Repairs**. Repair isolated random cracks and single holes not over 1 inch in diameter by dry pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry pack mortar before bonding compound has dried. Compact dry pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

E. **Approval**. Perform structural repairs with prior approval of Engineer/Architect for method and procedure, using specified epoxy adhesive and mortar.

F. **Alternative Repair Methods**. Repair methods not specified above may be used, subject to acceptance.

3.5 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. **General**. Employ an approved testing laboratory to perform tests and to submit test reports. ACI Grade 1 certified technician employed by the testing laboratory shall be present during the placing of all concrete. The concrete testing laboratory shall send two copies of all test reports directly to the Engineer/Architect.

B. **Sampling Fresh Concrete**. Sample concrete in accordance with ASTM C 172, except modified for slump to comply with ASTM C 94.

1. Slump. Slump tests shall be performed at the point of truck discharge prior to adding plasticizers in accordance with ASTM C 143. For each class of concrete, perform one test for each compressive strength test and additional tests when concrete consistency seems to have changed. If the slump is adjusted at the job site, the concrete testing agency shall be responsible for reporting the following.

   a. Method used to adjust slump.

   b. Quantity of each material added.

   c. Resulting slump.

2. Air Content. Perform daily for each class of concrete placed in accordance with ASTM C 173 volumetric method for lightweight concrete; ASTM C 231 pressure method for normal weight concrete; one test for each compressive strength test, one test for the first load of each type of air entrained concrete delivered, and one test for each truck when air content is adjusted until consistent results are obtained.

3. Concrete Temperature. Test hourly when air temperature is 40° F. (4° C.) and below, when 80° F. (27° C.) and above, and each time a set of compressive test specimens is made.

4. Compressive Test Specimen. Perform in accordance with ASTM C 31 and as follows:

   a. Prepare one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cured test specimens are required. Contractor may also prepare field cured test specimens to be used for early form removal.

   b. Prepare one set of cylinders for each 100 cy of concrete or fraction thereof, of each concrete class placed in any one day.

   c. Perform compressive strength tests in accordance with ASTM C 39. Test one specimen at 7 days, and two specimens at 28 days, and hold one specimen in reserve for later testing if required.

   d. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

   e. When total quantity of a given class of concrete is less than 50 cy, Engineer/Architect may waive strength test if adequate evidence of satisfactory strength is provided.

   f. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

   g. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

C. **Compressive Strength Test Reporting**. Test results will be reported in writing to Engineer/Architect, Ready-Mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. **Flatness and Levelness**. Conduct random tests for flatness and levelness in accordance with ASTM E 1155 within 24 hours after final finish and as directed. Pay the cost for testing and any retesting of the areas found not to conform to the specifications after the Contractor has corrected the defects.

E. **Floor Slope**. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope within 24 hours after final finish and as directed.

F. **Nondestructive Testing**. Impact hammer, ultrasonic pulse velocity, or other nondestructive device may be permitted if approved, but shall not be used as the sole basis for acceptance or rejection.

G. **Additional Tests**. The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure. These tests shall be as directed. Testing service shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Be responsible for all costs associated with such tests.

3.6 DEMONSTRATION

A. **General**. Prior to final acceptance of concrete work, demonstrate to representatives of the Owner and the Engineer/Architect that there are no mechanical defects or damaged areas and that concrete exposed to view is acceptable as to function and appearance.

1. Walls and Other Formed Surfaces. Representatives of the Owner, Contractor, and Engineer/Architect shall review concrete work to verify that tie holes and air voids have been patched, seams have been ground smooth, all surface defects have been repaired, and all rubbed or rubbed and painted surfaces are acceptable in appearance.

2. Floors. Representatives of the Owner, Contractor, and Engineer/ Architect shall review concrete work to verify that all surface defects have been repaired, all stains removed, residue from floor sealer/dustproof or chemical hardener has been removed, and that the required finish is acceptable. Where requested, flood selected areas of floor to a depth satisfactory to demonstrate that the area or areas drain properly to the floor drains and sumps and that there are no areas ponding water outside acceptable tolerances. Furnish water for testing and convey it to the areas being examined.

3. Liquid-Bearing Structures. All structures designed to hold water or other liquids shall be demonstrated to be watertight in accordance with ACI 350.

B. **Repair or Replacement of Defective Work**. Correct concrete work which is unacceptable in accordance with paragraph 3.4 of this section entitled "Concrete Surface Repairs." Remove concrete which, in the opinion of the Engineer/Architect, cannot be repaired satisfactorily and replace in an acceptable manner at no additional cost to the Owner.

3.7 CONCRETE CURING AND PROTECTION

A. **General**. Protect freshly placed concrete from premature drying and excessively cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation control compound. Apply in accordance with manufacturer's instructions.

B. **Curing Duration**. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 7 days. Maintain concrete temperatures as recommended in ACI 301 throughout the curing period.

C. **Curing Methods**. Perform curing of concrete by curing compound, by moist curing, by moisture-retaining-cover curing, and by combinations thereof in accordance with the schedule below unless curing method is specifically noted on the drawings. If unspecified, Contractor may opt for any of the methods specified below. Prior to use of curing compound on any surface, verify compatibility between curing compound and finish surface treatment.

Location	**Curing Method**
Floors and other unformed concrete surfaces	Any specified curing method
Formed concrete surfaces	Moist curing prior to form removal, followed by any of the methods specified below
Slabs to receive grout topping	Moisture cure
All other concrete	Any specified curing method

1. Moisture Curing. Provide moisture curing by following methods:
   a. Keep concrete surface continuously wet by covering with water.
   b. Use continuous water fog spray.
   c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing. Provide moisture-cover curing as follows:
   a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound. Provide curing compound as follows:
   a. Apply specified curing compound to concrete as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). For formed surfaces, apply curing compound immediately after form removal. Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Apply in two coats, spread in perpendicular directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
   b. Use curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
   c. Do not use curing compounds on surfaces which are to be covered with coating material applied directly to concrete, chemical hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue down carpet that is not compatible with curing compound), painting,

and other coatings and finish materials, unless otherwise approved.

3.8 SHORES AND SUPPORTS

A. Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.

B. **Extend shoring from ground to roof** for structures four stories or less, unless otherwise permitted.

C. **Extend shoring at least three floors** under floor or roof being placed for structures over four stories. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.

D. **Remove shores and reshore** in a planned sequence to avoid damage to partially cured concrete or to supporting floors. Locate and provide adequate reshoring to support work without excessive stress or deflection.

E. **Keep reshores in place** a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.9 REMOVAL OF FORMS

A. **Formwork which is not supporting** the weight of concrete, such as sides of beams, walls, columns, and similar parts of the work may be removed after cumulatively curing at not less than 50° F. (10° C.) for 24 hours after placing concrete, provided concrete is sufficiently hard not to be damaged by form removal operations, and provided curing and protection operations are maintained.

B. **Formwork supporting weight** of concrete, such as beam soffits, joists, slabs, and other structure elements, may not be removed in less than 14 days and until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field cured specimens representative of concrete location or members.

C. **Form facing material may be removed** 3 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.10 PROTECTION OF FORMED AND UNFORMED CONCRETE SURFACES

A. Protect concrete from damage or discoloration during the construction period caused by subsequent work performed by all other trades, including, but not limited to, concrete forming, resteel placement, equipment installation, plumbing work, electrical work, construction loading to the point of overstressing concrete, and all other actions which might adversely affect the strength or appearance of the concrete. Repair of chipped or damaged concrete and removal of rust, stains, efflorescence, and surface deposits shall be accomplished by acceptable methods.

END OF SECTION

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SECTION 03 41 02

STRUCTURAL PRECAST CONCRETE VAULTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain some requirements that relate to this section:

1. Division 3 for cast-in-place concrete and non-shrink grouting.
2. Division 5 for miscellaneous metals and anchors.
3. Division 7 for caulking.
4. Division 9 for painting.
5. Division 31 for excavation, excavation support, dewatering, and fill materials.
6. Division 33 for pipe penetrations and pump station requirements.
7. Division 40 for pipe and accessory supports.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to install the precast structures in accordance with the plans and as specified herein.

B. **Extent of precast work required by this section** is indicated on drawings and by requirements of this section.

C. **Minimum Size Requirements**. The dimensions of the precast concrete structure shown on the plans are minimum dimensions that must be maintained for placement of the piping arrangement shown. Any changes or variations from that shown on the plans and specified due to manufacturer's variations shall be at no cost to the Owner. The Contractor is responsible for any changes caused by the manufacturer unit he chooses to furnish.

D. **Openings in Precast Concrete**. The manufacturer of the precast concrete structure shall be responsible for all pipe sleeve penetrations and access hatches. Provide and install all concrete supports, piping, valves, and related accessories as shown on the plans.

E. **Ladder Rungs**. The manufacturer of the precast concrete structure shall be responsible for providing the units with ladder rungs where shown on the plans.

F. **Ladders**. The manufacturer of the precast concrete structure shall be responsible for providing the units with ladders where shown on the plans.

G. **Grating and Grating Support Structure**. The manufacturer of the precast concrete structure shall be responsible for providing the units with grating and grating support structures where shown on the plans.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with precast vaults in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. ASTM C 857, "Minimum Structural Design Loading for Underground Precast Concrete Utility Structures."
2. ACI 301, "Specifications for Structural Concrete for Buildings."
3. ACI 318, "Building Code Requirements for Reinforced Concrete."
4. AWS D1.1, "Structural Welding Code: Steel."
5. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
6. Prestressed Concrete Institute MNL 116, "Manual for Quality Control for Plants and Production of Precast Concrete Products."

B. **Manufacturer Qualifications**. Manufacturers of the precast units shall be firms regularly engaged in manufacturing factory fabricated units similar to the types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. The manufacturer must be a member of the Prestressed Concrete Institute (PCI) and/or participate in its Plant Certification Program.

C. **Manufacturers Design.** The structural design and shop drawings for the precast units shall be stamped by a Professional Engineer registered in the State of Ohio. The design loadings shall be as shown on the drawings, as specified herein, in conformance to industry guidelines, and as required for compliance with local governing codes.

1.4 SUBMITTALS

A. **General**. Furnish manufacturer's product data, test reports, and material certification as required by Section 01 33 00, "Submittals."

B. **Submittals**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Laboratory test reports for concrete materials and mix design tests. Shop drawings and structural calculations shall be submitted to the Engineer/Architect for approval. Shop drawings shall include fully dimensioned layout drawings, location of openings in units, structural details, reinforcement, lifting devices, connections and anchorages, unit identification number and order of installation, and any other information necessary to establish exactly what is being furnished and to determine compliance with the plans and specifications. Fabrication and installation shall be in accordance with the approved shop drawings. Shop drawings shall be stamped by a professional engineer legally authorized to practice in the jurisdiction where the project is located.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General.** Handle precast concrete vaults carefully to prevent external and internal component damage, breakage, cracking, or scoring. Do not install

damaged equipment; either replace damaged components or return unit to factory for replacement.

B. **Comply with manufacturer's rigging and installation instructions** for unloading precast concrete vaults and setting in final location.

C. **Store precast concrete units at site** as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.7 SPECIAL WARRANTY (Not used.)

PART 2 PRODUCTS

2.1 MATERIALS

A. Precast Concrete Structural Requirements

1. General

a. Design shall conform to ASTM C 857 where appropriate.

b. Top slabs shall be capable of supporting H-20 truck loads.

c. Wall loadings shall be based upon 0 to 65 pcf fluid load on the interior and 85 pcf equivalent fluid load plus 80 psf (horizontal) surcharge load on the exterior.

d. Minimum wall thickness shall be 8", minimum top slab thickness of 12", and minimum bottom slab thickness of 14".

e. Bottom slabs of all units shall be capable of resisting the anchor loads for the thrust blocks shown on the drawings.

f. Joints shall be gasketed and watertight.

g. Structure shall be designed to resist buoyancy.

2. Concrete

a. Portland Cement. ASTM C 150, Type I or Type III.

b. Use only one brand and type of cement throughout project, unless otherwise acceptable to Engineer/Architect.

c. Aggregates. ASTM C 33, and as specified here. Provide aggregates from a single source for exposed concrete.

1) Local aggregates not complying with ASTM C 33, but that have shown by special test or actual service to produce concrete of adequate strength and durability, may be used when acceptable.

d. Lightweight Aggregate. ASTM C 330.

e. Water. Potable.

f. Admixtures, General. Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.

g. Air-Entraining Admixture. ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

h. Water-Reducing Admixture. ASTM C 494 Type A, or other type approved for fabricator’s units.

i. Mix Proportion and Design.

1) Prepare design mixes for each type of concrete required.

2) Design mixes may be prepared by independent testing facility or by qualified precast manufacturing plant personnel at precast manufacturer's option.

3) Proportion mixes by either laboratory trial batch or field experience methods using materials to be employed on the project for each type of concrete required complying with ACI 318.

a) Produce standard weight concrete consisting of specified portland cement, aggregates, admixtures, and water to produce the following properties:

(1) Compressive strength 5,000 psi minimum at 28 days.

(2) Release strength for prestressed units – 3,500 psi.

b) Cure compression test cylinders using same methods as for precast concrete work.

4) Admixtures. Use air-entraining admixture in concrete, unless otherwise indicated.

a) Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low slump concrete, may be used subject to acceptance.

b) Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

3. Reinforcing

a. Reinforcing Bars. ASTM A 615, Grade 60, deformed.

b. Welded Wire Fabric. ASTM A 185.

c. Welded Deformed Steel Wire Fabric. ASTM A 497.

d. Supports for Reinforcement. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations.

4. Grout, See Specification 03 62 00.

5. Connection Materials

a. Steel Plates, Type 304 stainless.

b. Steel Shapes, Type 304 stainless.

c. Anchor Bolts. Type 316 stainless steel bolts, hexagon nuts, and washers.

d. High Strength Threaded Fasteners. Heavy hexagon structural bolts, and hardened washers, Type 316 stainless steel.

e. Welding Electrodes. Comply with AWS standards.

f. Accessories, Type 316 stainless steel. Provide clips, hangers, and other accessories required to install project units and to support subsequent construction or finishes.

6. Coating

a. Coat exterior below-grade walls. See Specification 09 90 00.

B. Precast Vault

1. Shall be built and shipped in sections. Submit section "layout" for review.

2. Pipe openings shall be made watertight and flexible.

3. Able to withstand H-20 live loads and dead loads including overburden load, soil side pressure and hydrostatic loading conditions.

4. Designed to resist buoyancy.

5. Install access steps where shown.

C. Precast Structures Hardware and Accessories

1. See pump specification for pump equipment attachments/locations.

2. Access Doors. Access doors shall be as shown on the plans and shall be capable of supporting an H-20 wheel load. The access doors shall be aluminum with stainless steel hardware. Frame shall be drainable type with upper rail bracket, chain hook, and cable holder. They shall have a frost proof lock which can be opened from the inside without a key. A wind catch shall be provided to keep the covers from coming shut under normal load. Access doors shall be Bilco Type JD-AL H-20 or equal. Access doors shall be furnished with safety grates.

D. **Steps**. Where shown or called for, install access steps at 12-inch centers. See Miscellaneous Metals specification for materials.

E. Precast Structure Appurtenances

1. Appurtenances. The following items as indicated and detailed on the plans shall be provided with the utility vault.

a. Mechanical expandable link-type rubber seal and steel wall sleeve to fill the annular space between a pipe and cored hole or sleeve which passes through the utility vault walls.

b. Cast iron bodied floor drain with 4-inch outlet pipe size, if shown.

c. Vent pipe with insect screen.

2.2 FABRICATION

A. **General.** Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL 116 and as specified for types of units required.

B. **Built-In Anchorages.** Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect the position of the main reinforcement or placing of concrete. Do not relocate bearing plates in units unless acceptable to Engineer/Architect.

C. **Cast in openings** larger than 10 inches in diameter or 10 inches square in accordance with final shop drawings. Other smaller holes may be field cut by trades requiring them, as approved by Engineer.

D. **Coat surfaces** of forms with bond breaking compound before reinforcement is placed. Provide commercial formula form coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and that will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's instructions.

E. **Clean reinforcement of loose rust** and mill scale, earth, and other materials that reduce or destroy the bond with concrete.

F. **Accurately position**, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers and hangers, as required.

G. **Place reinforcement** to obtain at least the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

H. **Pretension tendons** for prestressed concrete either by single strand tensioning method or multiple strand tensioning method. Comply with PCI MNL-116 requirements.

I. **Place concrete** in a continuous operation to prevent seams or planes of weakness from forming in precast units, complying with requirements of ACI 304. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items.

J. **Identify pick-up points and orientation** in structure with permanent markings, complying with markings indicated on final shop drawings. Imprint casting date on each precast unit on a surface that will not show in the finished structure.

K. **Finish formed surfaces** of precast concrete as indicated for each type of unit, and as follows:

1. Standard Finish. Normal plant run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color variations and form joint marks, and minor chips and spalls will be tolerated. Major or unsightly imperfections, honeycomb, or structural defects are not permitted.

L. **Finish unformed surfaces** by trowel unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth uniform finish.

1. Apply scratch finish to precast units that will receive concrete topping after installation. Following initial strikeoff, transversely scarify surface to provide ridges approximately 1/4 inch deep.

2.3 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:

1. Precast Pump Station and Vaults.

a. Lindsay Concrete.

b. Mack Industries, Inc.

c. Norwalk Concrete Industries.

2. Aluminum Frames and Covers.

a. Bilco Co.

b. Halliday Industries.

c. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General**. Provide units of sizes, shapes, and locations as indicated. Determine final grading as influenced by possible adjustments in other utilities and surface features or underground obstructions before installing vault. Obtain approval for vault installation adjustments necessitated by the above. Install units plumb and level and with orientation and depth coordinated. Support on bedding material as shown on drawings.

B. **Install in accordance with ASTM C 891**, "Practice for Installation of Underground Precast Concrete Structures," and manufacturer's instructions.

C. **Elevation**. Install units with rooftop at elevation indicated on plans.

D. **Drainage**. Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.

E. **Precast Access**. Install access to structures through cast aluminum frame and cover. Caulk all seams and joints inside and out. Set frames in paved areas and traffic ways flush with finished grade.

F. **Welding.** Perform welding in compliance with AWS D 1.1 and D 1.4, including qualification of welders.

1. Protect units from damage by field welding or cutting operations and provide noncombustible shield as required.

2. Repair damaged metal surfaces by cleaning and applying a coat of liquid galvanizing repair compound to galvanized surfaces and a compatible primer to painted surfaces.

G. **Powder Actuated Fasteners.** Do not use powder actuated fasteners for attaching accessory items to the surface of a precast, prestressed unit.

H. **Erection Tolerances.** Install precast units without exceeding tolerance limits specified in PCI MNL 127 "Recommended Practice for Erection of Precast Concrete."

1. Grouting Connections and Joints. After precast concrete units have been placed and secured, grout open spaces at connection and joints.

I. **Waterproofing**. Where shown and/or specified apply waterproofing to exterior surfaces of units after concrete has cured at least 3 days. Apply in accordance with requirements herein. After pipes have been connected and grouted in, and prior to backfilling, waterproof joints and connections and touch up abrasions and scars.

J. **Field-Installed Bolting Anchors**. Do not drill deeper than 3 7/8 inches for anchor bolts installed in the field.

3.2 SOURCE QUALITY CONTROL

A. **Dimensional Tolerances.** Units having dimensions smaller or greater than required and outside specified tolerance limits may be subject to additional testing as specified here.

B. **Precast units** having dimensions greater than required will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units, as required, to meet construction conditions.

C. **Strength of precast concrete units** will be considered potentially deficient if the manufacturing processes fail to comply with any of the requirements that may affect the strength of the precast units, including the following conditions:

1. Failure to meet compressive strength tests requirements.

2. Reinforcement not conforming to specified fabrication requirements.

3. Concrete curing, and protection of precast units against extremes in temperature not as specified.

4. Precast units damaged during handling and erection.

D. **Testing Precast Units.** When there is evidence that the strength of precast concrete units may not meet specification requirements, the Owner will take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C 42.

E. **Patching.** Core test holes or minor irregularities (as accepted by Engineer) shall be filled with patching mortar and finished to match adjacent concrete surfaces.

F. **Defective Work.** Remove precast concrete units that do not conform to specified requirements, including strength, tolerances, and finishes. Replace with precast concrete units that meet requirements of this section.

3.3 CLEANING AND RESTORATION

A. **Cleaning**. Clean all internal surfaces including sump and remove all foreign material.

B. **Restoration**. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore all areas disturbed by trenching, storing of dirt, and other work to their original condition. The restoration shall include a necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Restore disturbed paving as indicated.

END OF SECTION

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SECTION 03 41 13

PRECAST PRESTRESSED HOLLOW CORE CONCRETE SLABS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Furnish and install the precast prestressed hollow core concrete slabs in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. PCI - Prestressed Concrete Institute.
2. ACI - American Concrete Institute.
3. ASTM - American Society for Testing and Materials.
4. AWS - American Welding Society.
5. UL - Underwriters' Laboratories, Inc.
6. AHA - American Hardboard Association.
7. CRSI - Concrete Reinforcing Steel Institute.

C. Qualifications

1. **Fabricator**. Firm responsible for fabrication of precast concrete slabs shall have at least 2 years of successful experience in the fabrication of precast concrete units similar to those required for this project, with sufficient production capacity to produce required units without causing delay in the work.

a. Fabricator shall design the precast slab units to support superimposed dead loads and live loads as required and for compliance with local governing code requirements.

b. Fabrication of precast slab units shall comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast Concrete Products."

c. Fabricator must be producer member of the PCI and/or participate in its Plant Certification Program.

D. **Fire Resistance-Rated Precast Units**. Where precast concrete units are shown or scheduled as requiring a fire resistance classification, provide units tested and listed by UL in "Fire Resistance Directory" or with each unit bearing UL label and marking.

1.4 SUBMITTALS

A. **Product Data**. Provide product data for manufactured materials and products. Include manufacturer's certifications and laboratory test reports where applicable.

B. **Shop Drawings**. Submit shop drawings showing complete information for fabrication and installation of precast concrete slabs.

1. Indicate member dimensions and cross section as well as location, size, and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.

2. Provide layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including headers, accessories, and construction at openings in precast units.

3. Indicate location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement.

4. Provide complete design calculations prepared and stamped by a registered engineer licensed in state where project is located.

C. **Certifications**. Provide evidence of fabricator's qualifications.

D. **Concrete Test Reports**. Submit concrete records which verify that compressive strength of concrete complies with specified values of compressive strength and release strength of precast units.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate with other trades to prevent delays, errors, or omissions. Provide anchorage items and setting diagrams, templates, and directions for installation of anchorage items that are to be embedded in other construction before start of such work.

B. **Masonry Work**. Masonry walls which support precast concrete slabs shall be completed a minimum of 7 days prior to setting precast concrete slabs.

C. **Grout Installation**. Do not grout precast concrete slab joints when ambient air temperatures are below 40 degrees Fahrenheit (° F.) or when raining unless protective measures are taken to prevent grout from freezing or being diluted by rain water during placement and curing period.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver precast concrete slabs to project site in such quantities and at such times to ensure continuity of installation.

B. **Storage**. If possible, install precast concrete slabs directly from delivery vehicle to final structure location. Where this is not possible, units may be stored at site on delivery vehicle trailer on a level surface.

C. **Handling**. Lift and support precast concrete slabs at designated lift points. Position slabs in final location with tools and in a manner which will not damage slabs.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. Formwork

1. Form Materials. Provide forms and, where required, form facing materials of metal, plastic, wood, or another acceptable material that is nonreactive with concrete and will produce required finish surfaces.

2. Form Construction. Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placing operations and temperature changes, and for prestressed, pretensioning, and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified in PCI MNL 116.

3. Form Design. Unless forms for plant manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced in precast units due to deformation of concrete under prestress or movement during detensioning.

B. Concrete Materials

1. Portland Cement. ASTM C 150, Type I or Type III.

   a. Use only one brand and type of cement throughout project unless otherwise acceptable to Engineer.

2. Aggregates. ASTM C 33. Provide aggregates from a single source for exposed concrete.

3. Lightweight Aggregate. ASTM C 330.

4. Water. Potable.

5. Admixtures, General. Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.

   a. Air-Entraining Admixture. ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

   b. Water-Reducing Admixture. ASTM C 494, Type A, or other Type approved for fabricator's units.

C. Reinforcing Materials

1. Reinforcing Bars. ASTM A 615, Grade 60, deformed.

2. Low Alloy Steel Reinforcing Bars. ASTM A 706.

3. Steel Wire. ASTM A 82, plain, cold drawn steel.

4. Welded Wire Fabric. ASTM A 185.

5. Welded Deformed Steel Wire Fabric. ASTM A 497.

6. Supports for Reinforcement. Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing, complying with CRSI recommendations.

a. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

D. Prestressing Tendons

1. Material. Uncoated, seven-wire, stress-relieved strand complying with ASTM A 416. Use Grade 250 unless Grade 270 is indicated.

2. Optional Material. A strand similar to above, but having the size and ultimate strength of wires increased so that the ultimate strength of the strand is increased approximately 15 percent, or a strand with increased strength but fewer number of wires per strand, may be used at manufacturer's option.

E. Connection Materials

1. Steel Weld Plates. Structural quality, hot rolled carbon steel, ASTM A 283, Grade C.

2. Steel Shapes. ASTM A 36.

3. Anchor Bolts. ASTM A 307, low carbon steel bolts, regular hexagon nuts, and carbon steel washers.

4. High-Strength Threaded Fasteners. Heavy hexagon structural bolts, and hardened washers complying with ASTM A 325.

5. Finish of Steel Units. Exposed units galvanized per ASTM A 153; others painted with rust inhibitive primer.

6. Bearing Pads. Provide bearing pads for precast concrete units as required.

a. Elastomeric Pads. Vulcanized, chloroprene elastomeric compound, molded to size or cut from a molded sheet, 50-60 shore A durometer.

b. Laminated Fabric Rubber Pads. Preformed, unused synthetic fibers and new, unvulcanized rubber. Surface hardness of 70-80 shore A durometer.

c. Frictionless Pads. Tetrafluoroethylene (TFE), with glass fiber reinforcing as required for service load-bearing stress.

d. Tempered Hardboard Pads. Smooth on both sides, complying with AHA A 135.4.

7. Welding Electrodes. Comply with AWS standards.

8. Accessories. Provide clips, hangers, and other accessories required to install project units and to support subsequent construction or finishes.

F. Grout Materials

1. Cement Grout. Portland cement, ASTM C 150 (Type I), and clean, natural sand, ASTM C 404. Mix at ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

2. Nonmetallic Shrinkage Resistant Grout. Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107, Grade B, with fluid consistency and a 30 minute working time.

3. Available Products. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Nonmetallic Shrinkage Resistant Grout.

1) Conspec 100 Non-Shrink Grout (Nonmetallic), Dayton Superior, Inc.

2) Supreme Grout, Cormix, Inc.

3) Sure Grip Grout, Dayton Superior.

4) Euco N.S., Euclid Chemical Co.

5) Crystex, L & M Construction Chemicals, Inc.

6) Masterflow 928, Master Builders, Inc.

7) Sealtight 588 Grout, W.R. Meadows.

8) Set Non-Shrink, Set Products, Inc.

9) Multi-Purpose Grout, Dayton Superior.

10) Portland Expanding Grout (Non-Shrink), Target Products, Ltd.

11) Five Star Grout, U.S. Grout Corp.

12) F-100, Sauereisen Cement Company

2.2 MIXES

A. **General**. Prepare design mixes for each type of concrete required. Design mixes may be prepared by an independent testing facility or by qualified precast manufacturing plant personnel at precast manufacturer's option.

B. **Mix Designs**. Proportion mixes by either laboratory trial batch or field experience methods using materials to be employed on the project for each type of concrete required complying with ACI 318 and in accordance with the following:

1. Produce standard weight concrete consisting of specified portland cement, aggregates, admixtures, and water to produce the following properties:

a. Compressive strength - 5,000 pounds per square inch (psi) minimum at 28 days.

b. Release strength for prestressed units - 3,500 psi.

C. **Adjusting Concrete Mixes**. Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Submit laboratory test data for revised mix designs and strength results for acceptance before use in the work.

D. Admixtures

1. Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion or provide increased workability for low slump concrete may be used subject to acceptance.

2. Use air-entraining admixture in concrete, unless otherwise indicated.

3. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

2.3 FABRICATION

A. **General**. Fabricate precast hollow core slab units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL-116 and as specified herein. Furnish units that are free of voids or honeycomb with straight true edges and surfaces.

B. **Built-In Anchorages**. Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect the position of the main reinforcement or placing of concrete. Do not relocate bearing plates in units unless acceptable to Engineer.

1. Include cast-in weld plates where required for anchorage or lateral bracing to structural steel members.

2. Cooperate with other trades for installation of items to be cast in hollow slab units. Notify Contractor of items not received in ample time so as not to delay work.

C. Reinforcement and Pretensioning Tendons

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.

2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.

3. Place reinforcement to obtain at least the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

4. Pretension tendons for prestressed concrete either by single strand tensioning method or multiple strand tensioning method. Comply with PCI MNL-116 requirements.

5. Delay detensioning prestressed units until concrete has attained at least 70 percent of the design stress, as established by test cylinders.

a. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.

b. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.

6. Adequately reinforce slab units to resist transporting and handling stresses.

D. Formwork

1. Accurately construct forms of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within specified fabrication tolerances.

2. Coat surfaces of forms with bond breaking compound before reinforcement is placed. Provide commercial formula form coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and that will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's instructions.

E. Concrete Placement and Curing

1. Cast-in openings larger than 10 inches in diameter or 10 inches square in accordance with final shop drawings. Other smaller holes may be field cut by trades requiring them, as acceptable to Fabricator.

2. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast units, complying with requirements of ACI 304. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items.

3. Identify pickup points and orientation in structure with permanent markings, complying with markings indicated on final shop drawings. Imprint casting date on each precast unit on a surface that will not show in the finished structure.

4. Cure by low-pressure steam, steam vapor, radiant heat and moisture, or another similar process to accelerate concrete hardening and to reduce curing time.

F. Finishes of Formed and Unformed Surfaces

1. Finish formed surfaces of precast hollow core slabs as follows:

a. Standard finish is normal plant run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color variations and form joint marks, and minor chips and spalls will be tolerated. Major or unsightly imperfections, honeycomb, or structural defects are not permitted. Provide standard finish units unless otherwise indicated.

b. Commercial finish is achieved by removing fins and large protrusions and filling large holes. Rub or grind ragged edges. Faces are to be true, well defined surfaces.

2. Finish unformed surfaces by trowel unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth uniform finish.

a. Apply scratch finish to precast units that will receive concrete topping after installation. Following initial strikeoff, transversely scarify surface to provide ridges approximately 1/4 inch deep.

G. Miscellaneous

1. Provide solid, monolithic precast slab units indicated to be an integral part of hollow slab unit system. Design and fabricate solid units to dimensions and details indicated as specified for hollow slab units.

2. Provide headers of structural steel shapes for openings larger than one slab width in accordance with hollow slab unit manufacturer's recommendations.

2.4 SOURCE QUALITY CONTROL

A. **General**. The manufacturer's production practices and quality control operations shall comply with PCI MNL 116 and as specified herein. Concrete testing may be accomplished by plant personnel, an independent testing laboratory employed by the precast manufacturer, or by a combination of both.

B. **Fabrication Tolerances**. Dimensional tolerances for precast hollow core slabs shall be as specified in PCI MNL 116.

C. **Additional Testing**. Where there is evidence that strength of precast concrete units does not meet specification requirements, the concrete testing laboratory shall take core drilled samples from hardened concrete for compressive strength determination, complying with ASTM C 42 and as follows:

1. Take at least three representative cores from precast units of suspect strength from locations directed by Engineer.

2. Test cores in a saturated surface dry condition per ACI 318 if concrete will be wet during use of completed structure.

3. Test cores in an air dry condition per ACI 318 if concrete will be dry during use of completed structure.

4. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent of 28 day design compressive strength (f'_c) and no single core is less than 75 percent of f'_c.

5. Test results shall be made in writing with copies delivered to Engineer, Contractor, and precast manufacturer. Include in test report the project identification name and number, date, name of precast concrete manufacturer, name of concrete testing service, identification letter, specific member or members represented by core tests, design compressive strength, compressive breaking strength and type of break (corrected for length diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of core at time of testing.

D. **Patching**. Where core test results are satisfactory and precast units are acceptable for use in work, fill core holes solid with patching mortar and finish to match adjacent concrete surfaces.

E. **Defective Work**. Precast concrete units that do not conform to specified requirements, including strength, dimensional tolerances, and finishes, shall be replaced with precast concrete units that meet requirements of this section. Be responsible for cost of corrections to other work affected by or resulting from corrections to precast concrete work.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Supporting Members. Prior to commencement of hollow core slab installation, verify that all supporting members are in place and secured. For masonry walls, verify that installation of masonry has been completed for a minimum of 7 days.

2. Anchorage Items. Verify that all anchorage items, weld plates, etc., which were to be embedded or installed in other parts of the structure have been installed correctly and in their proper location.

3.2 INSTALLATION

A. **Bearing Pads**. Install flexible bearing pads where indicated as hollow slab units are being set. Set pads on level, uniform bearing surfaces and maintain in correct position until precast units are placed.

B. **Welding**. Perform welding in compliance with AWS D 1.1 and D 1.4, including qualification of welders.

1. Protect units from damage by field welding or cutting operations and provide noncombustible shield as required.

2. Repair damaged metal surfaces by cleaning and applying a coat of liquid galvanizing repair compound to galvanized surfaces and a compatible primer to painted surfaces.

C. **Powder-Actuated Fasteners**. Do not use powder-actuated fasteners for attaching accessory items to the surface of hollow slab units unless otherwise accepted by precast manufacturer.

D. **Erection Procedures**. Follow erection procedures and sequence of erection as recommended by hollow slab unit manufacturer and as acceptable to Engineer.

1. Installation Tolerances. Install precast units without exceeding following tolerance limits:

a. Variations from Plumb. 1/4 inch in any 20-foot run or story height; 1/2 inch total in any 40-foot or longer run.

b. Variations from Level or Elevation. 1/4 inch in any 20-foot run; 1/2 inch in any 40-foot run; total ±1/2 inch at any location.

c. Variation from Position in Plan. ±1/2 inch maximum at any location.

d. Offsets in Alignment of Adjacent Members at Any Joint. 1/16 inch in any 10-foot run, 1/4 inch maximum.

2. Level slabs accurately or set to uniform slope as indicated.

3. Set slabs on solid, level bearing, with bearing surface of slab units not less than 2 inches at steel supports and not less than 3 inches at other supports, unless otherwise acceptable to Engineer.

4. Align and level by methods, procedures, and equipment as recommended by hollow slab unit manufacturer.

5. Do not cut holes or install sleeves larger than size permitted by hollow slab unit manufacturer for pipe, conduits, duct, or other penetrations after fabrication.

6. Do not cut reinforcing or prestressing strands without approval of manufacturer.

7. Field cut holes for openings that do not disturb prestressing strands in accordance with recommendations of hollow slab unit manufacturer.

8. At continuous electrical raceway joints, carefully align cells and tape butt joints in accordance with manufacturer's recommendations and to comply with applicable code requirements. Keep hollow cores free from grout and other foreign materials.

E. **Grouting Connections and Joints**. After hollow core slabs have been placed and secured, grout open spaces at connections and joints as follows:

1. Provide cement grout consisting of 1 part portland cement, 3 parts sand, and only enough water to properly mix and hydrate.

2. Provide shrinkage resistant grout consisting of premixed compound and water to provide a flowable mixture without segregation or bleeding.

3. Provide forms or other acceptable method to retain grout in place until sufficiently hard to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, plumb, and level with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

3.3 **DEMONSTRATION.** After installation of the precast hollow core slabs, but prior to grouting of same, demonstrate to representatives of the Owner and/or the Engineer by visual inspection that the hollow core slabs have been installed in accordance with the installation tolerances specified in paragraph 3.2 D.1. The visual inspection shall also identify damaged or honeycombed areas in the hollow core slabs which require repair or replacement. Hollow core slabs which have been repaired by the Contractor shall be reinspected by the Owner and/or Engineer. Hollow core slabs which cannot be repaired to the satisfaction of the Owner and Engineer shall be replaced at no additional cost to the Owner. Payment for precast hollow core slabs shall be authorized for those units which are installed properly and exhibit no visible defects.

END OF SECTION

SECTION 03 62 00

GROUTING, NONSHRINK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the nonshrink grout in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work to furnish and install the nonshrink grout in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards referenced herein.

1. ASTM - American Society for Testing and Materials.

1.4 UBMITTALS

A. **Product Data**. Submit manufacturer's technical data and installation instructions for each type of grout. Technical data shall show manufacturer's trade name, color, all independent laboratory tests, performance data, method of application, storage requirements, safety fact sheet, container sizes, and mixing instructions.

1.5 JOB CONDITIONS

A. **Surface Preparation.** Clean all surfaces to be grouted of loose mortar and concrete and all dirt and oil.

B. **Coordination**. Coordinate all work with other trades to prevent delays, omissions, damage, and/or interference with other work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Grout shall be delivered to the site in sealed containers bearing a label which shall list the manufacturer's name, trade name, application rate, precautionary methods required, mixing ratio, and expiration date.

B. **Storage**. Store materials in an enclosed dry area, protected from damage and moisture. Keep storage areas clean and neat at all times.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIAL

A. Grout shall be nonshrink, nonmetallic, nonstaining, capable of developing a minimum compressive strength of 8,000 pounds per square inch (psi) at 28 days, when tested in 2-inch cubes in accordance with ASTM C-109. Grout shall be

free of any metal, plastic, gypsum, and chemicals, and guaranteed not to shrink below its original placement volume at any time.

2.2 MANUFACTURER

A. Nonshrink grout shall be one of the following:

1. Five Star Grout or Fluid Grout 100 by Five Star Products, Inc.
2. F-100 by Sauereisen Cement Company.
3. Masterflow 928 by Master Builders.
4. NS Grout by Euclid Chemical Company.
5. Or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Verification**. Confirm that all dimensions, elevations, and tolerances are correct prior to placing grout. Equipment shall be free of any vibration and properly supported when operated prior to placing grout.

3.2 PREPARATION

A. **Surface Preparation**. Clean all areas to be grouted so they are free of all oils, grease, laitance, loose particles, and foreign materials. Thoroughly wet all concrete to be grouted leaving no puddles prior to grouting. Surface preparation shall be done in accordance with the grout manufacturer's recommendations.

3.3 INSTALLATION

A. **Placement**. Mix, place and cure nonshrink grout in accordance with the manufacturer's instructions. Fill all voids and spaces, trim excess grout, and finish surface to match adjoining surfaces or as directed. Maintain a surface temperature of not less than 50 degrees Fahrenheit (° F.) for 7 consecutive days after placing the grout and keep the grout wetted for 3 consecutive days after placing.

B. Items to Be Grouted (Where Applicable)

1. Pipe, Equipment, Leveling Plates, and Base Plates. After shimming equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates, allowing sufficient room around the edges for placing the grout. Provide adequate depth between the bottom of the base plate and the top of the concrete base (1" minimum) to ensure that the void is completely filled with grout.
2. Rail and Fence Posts. After all posts have been properly inserted into the holes, fill the annular space between posts and concrete with the nonshrink, nonmetallic grout. Bevel grout at juncture with post so that moisture flows away from the post.
3. Box Outs and Closing of Openings. Grout all box outs and other openings approved due to late deliveries and required to maintain the work schedule full as shown on the drawings and as specified under paragraph 3.3 A of this section.
4. As required.

3.4 FIELD QUALITY CONTROL

A. **Areas to Be Grouted**. Observe and confirm that all surfaces to be grouted are cleaned of loose mortar and concrete and all dirt and oil.

B. **Shrinkage Cracks**. Visually inspect grouted areas after 3 months and 1 year for evidence of shrinkage cracks. Replace any grout which shows evidence of cracks.

END OF SECTION

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SECTION 03 64 23

EPOXY INJECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Special Conditions, Division 1, and all related specification sections, apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, and equipment necessary to repair cracks or joints in concrete where shown on the drawings and specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Comply with provisions of the following standards:

1. ASTM – American Society for Testing and Materials.

2. NSF – National Sanitation Foundation.

C. **Experience**. The Contractor shall have a minimum of 5 years' successful experience in epoxy injection of the specified products.

D. **Superintendent**. The superintendent assigned to the project must have supervised five prior projects of similar magnitude. Job superintendent shall control all operations as necessary for full compliance with all requirements.

E. **Technician**. The lead epoxy injection mechanic assigned to the project must have worked on three similar projects and have a minimum of 2 years' experience.

F. **On Site**. The superintendent or lead technician shall be on the job site at all times all work related to crack injection is being performed.

G. **Equipment**. Submit records showing that Contractor has owned and operated the epoxy injection equipment, or similar epoxy injection equipment, for a minimum of 2 years.

H. **Manufacturer's Representative**. Product manufacturer's technical representative shall provide the Contractor such aid and instruction as is required to obtain proper application of the product.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's technical data and installation instructions for each material, including manufacturer's trade name, all independent laboratory tests, performance data, method of application, storage requirements, safety fact sheet, container sizes, and mixing instructions.

1. Provide a list of at least five projects similar in concept which he has completed in the last 5 years as a certified applicator. Such lists shall include:

2. Project name and location.

3. Client's name, address, and telephone number.

4. Project consultant.

1.5 JOB CONDITIONS

A. Coordination

1. Coordinate with Owner so as not to interfere with operation of the facility.

2. Coordinate installation of joint materials, embedded items, etc., with placement of forms and reinforcing steel. Coordinate concrete work with all other trades to prevent delays, errors, or omissions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Material must be brought to the job site** in unopened containers and clearly marked by manufacturers to show that material is less than 1 year old at time of placement. Store material in cool, dry area where temperatures do not exceed 80 degrees Fahrenheit (° F.) for prolonged periods.

1.7 SPECIAL WARRANTY Not used.

PART 2 PRODUCTS

2.1 MATERIALS

A. **Crack Repair Resin**. Crack repair resin shall be a two-component, 100-percent-solid, moisture-insensitive epoxy conforming to ASTM C 881 formulated to repair cracks in concrete and having the following properties:

Viscosity exceed	170 (cps)
Minimum 14 flexural strength (ASTM D 790)	5,000 pounds per square inch (psi)
Minimum 14-day modulus of elasticity (ASTM D 790)	3.7×10^5
Minimum 14-day tensile strength (ASTM D 638)	6,000 psi
Minimum elongation to break	2.5 percent
Bond strength (ASTM C 882) hardened concrete to hardened concrete	2 day (dry cure), 3,000 psi 4 day (wet cure), 2,000 psi

1. Available Products. All products that come in contact with drinking water must meet NSF 60/61 requirements for drinking water applications. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Sika Injection-307, Sika Corp.

B. **Epoxy Paste**. Epoxy paste shall be a two-component, 100-percent-solid. moisture-insensitive, nonsagging epoxy paste conforming to ASTM C 881 formulated to seal crack surface during injection and having the following properties:

14-day tensile strength (ASTM D 638)	3,500 (psi)
14-day modulus of elasticity (ASTM D 638)	3.7×10^5
Bond strength (ASTM C 882) hardened concrete to hardened concrete	2 day (dry cure), 3,000 psi 14 day (wet cure), 2,200 psi

1. Available Products. All products that come in contact with drinking water must meet NSF 60/61 requirements for drinking water applications. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

   a. Sikadur-30, Sika Corp.

PART 3 EXECUTION

3.1 PREPARATION

A. **Remove all dust, laitance, grease**, curing compounds, impregnations, waxes, foreign particles, and disintegrated materials to expose bare concrete from crack and concrete surface adjacent to the crack.

3.2 EXAMINATION

A. **Inspect all of the areas** and surfaces to be epoxy injected.

3.3 EQUIPMENT

A. **Demonstrate equipment's ability** to pump and dispense the injection resin at sufficient pressures to fully seal all size joints and cracks. Use proper grouting equipment designed for the application of the specified materials.

B. **Demonstrate that pumping equipment** can maintain this pressure for 5 minutes with no leaks or drop in pressure.

3.4 INSTALLATION

A. Sequence of Work

1. Accomplish demolition of concrete within 10 feet of cracks to be injected prior to injecting the cracks.

2. Accomplish grouting under the slab within 10 feet of cracks to be injected prior to injecting the cracks.

B. **Use repair procedure** in accordance with the epoxy resin manufacturer's written instructions and, in general, include the following steps as needed for crack repairs, contaminated cracks, or rough surfaces.

1. Clean all areas to be injected. Remove all debris, mineral deposits, and existing sealant materials so that cracks and joints can be seen clearly enough to lay out the porting pattern. Use one or more of the following techniques:

   a. Hammer and chisel.

   b. Wire brush.

c. Grinding wheel.

d. Sandblast.

e. Power washing.

2. Drill standard holes for ports approximately 1/2 inch into the surface of the cracks. Spacing of the holes normally varies from 6 inches up to 24 inches apart, depending upon the thickness of the concrete structure being repaired and known depth of the cracks.

3. Pressure-wash the holes and cracks clean using a 3,000-psi system. Contaminated cracks may need chemical flushing. If water cannot be used, then vacuum drill bits and high-pressure air may be used to blow cracks clean.

4. Wait 8 hours or an adequate time for cracks to dry.

5. Install ports into the drilled holes. Recess each port to secure seating.

6. Seal around ports and the crack surface using the epoxy paste. Seal the crack on the opposite side of the structure so that epoxy resin does not leak out.

7. When the sealer is fully cured, begin the epoxy injection at the lowest entry port on vertical surfaces. Begin the epoxy injection at the widest side of the crack on horizontal surfaces.

   a. For structural cracks, inject with sufficient pressure until pure resin flows out the next port, then cap the port and move onto that flowing port. Continue injecting the length of the crack until the full length is injected.

   b. For nonstructural crack, the injection pressure must be limited so as not to cause movement of the concrete adjacent to the crack. Inject slowly, allowing time for epoxy to flow into crack. Filling the full depth of the crack is not required, but seal the crack surface with injection epoxy; space ports closer if required. Cap the port and move to next port. Continue injecting the length of the crack until the full length is injected.

3.5 CLEANUP

A. **After injection epoxy has cured,** remove epoxy paste from top surface of slabs, edges of slabs, tops of walls, and sides of wall to 2 feet below top of wall, then grind the surface smooth and remove excess resin from the surface of the structure.

3.6 FIELD REPORTS

A. **At the completion of the work** provide a report stating materials used, length of crack injected, whether structural or nonstructural, and if crack was filled. Prepare as-built drawings showing location and length of structural and nonstructural crack repair.

END OF SECTION

SECTION 04 05 01

MASONRY, MORTAR AND GROUT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, tools, equipment, and materials necessary to furnish and install the mortar and grout for masonry work in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ACI - American Concrete Institute.
2. ANSI - American National Standards Institute.
3. ASTM - American Society for Testing and Materials.
4. NCMA - National Concrete Masonry Association.
5. UL - Underwriters' Laboratories, Inc.

C. **Source**. Use one source and brand for mortar materials throughout the course of the project.

1.4 SUBMITTALS

A. **Product Data**. Submit product data on each unit of material.

B. **Samples**. Submit sample showing range and color for each type of colored mortar.

1. Label samples to indicate name of color, type of colorant, and the amount of colorant used in a specific mix.

C. Certification

1. Submit certified testing laboratory reports for the mortar mix in accordance with ASTM C 270, "Mortar for Unit Masonry."
2. Submit manufacturer's certificates as called for.

D. Mix Design and Test Results

1. Submit grout mix design and strength reports in conformance with ACI 301 “Flowchart for Selection of Concrete Mixtures.”

1.5 JOB CONDITIONS

A. Climatic

1. No mortar shall be mixed in temperatures below 40 degrees Fahrenheit (° F.).

2. No frozen or contaminated materials shall be used.

B. **Volume Control**. Maintain an accurate size container on the job at all times to ensure proper proportioning of cement, lime, and sand. A graduated container shall be utilized for quantifying admixtures.

1.6 DELIVERY, STORAGE, AND HANDLING.

A. Delivery

1. Packaged Units. Deliver in sealed units, palletized, clearly marked as to manufacturer, material, weight and/or volume, handling requirements, and all else necessary complete with instructions for its use.

2. Bulk. Bulk items such as sand shall be delivered covered and kept separate from other bulk items, unloaded in prepared designated areas.

B. Storage

1. Keep all units off the ground, under cover, and in a dry location.

2. All cementitious materials that become wet shall not be used and shall be removed from the site.

3. All sand shall be covered with a waterproof covering weighted down to keep rain, snow, and contaminants off the sand.

C. **Handling**. Handle material in a manner that will minimize contamination. Handle all chemicals in strict accordance with manufacturer's recommendations and/or instructions. All material in direct contact with the ground shall not be used.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. **Portland Cement**. Cement shall be Type 1, meeting ASTM C 150, "Portland Cement," nonstaining without air entraining and of natural color or white as required to produce the required color.

B. **Lime**. Lime shall be hydrated, Type S, conforming to ASTM C 207, "Hydrated Lime for Masonry Purposes." Provide certificate that lime meets ASTM C 207.

C. Sand

1. Gradation. Masonry sand shall pass 100 percent through a No. 16 sieve.

2. Type.

a. Natural. Sand shall be clean, sharp, conforming to ASTM C 144, "Aggregate for Masonry Mortar."

b. Naturally Colored. Sand shall be ground marble, granite, or other sound stone required to match the reviewed sample.

c. White Sand. Clean, hard, silicaceous material free of loam, silt, or other impurities.

D. **Aggregate**. Aggregate for coarse grout shall meet ASTM C 404, "Aggregate for Masonry Grout," Table 1, Coarse Aggregate.

E. Color Pigments

1. Type.

a. Commercial iron oxide.

b. Manganese dioxide.

c. Ultramarine blue.

d. Chromium oxide.

e. Carbon black.

2. Ratio. Pigment to cement ratio by weight:

a. Carbon Black - 1 to 35

b. Other - 1 to 10

F. **Water**. Water shall be clean, free from deleterious amounts of sewage, oils, acids, alkalis, clay, or organic material.

G. Admixtures

1. Waterproofing Type. Waterproofing admixtures shall be composed of balanced colloidal blends of water repellent stearates, water reducing agent, and a neutral carrier.

a. Product and manufacturer.

1) Omicrom by Master Builders.

2) Hydrocide Powder by Sonneborn Building Products.

3) Hydrolox 400 by Chem-master Corporation.

2. Nonfreeze Type. The following nonfreeze additives are not permitted.

a. Antifreeze or its agents.

b. Calcium chlorides.

c. Sodium chlorides.

H. Epoxy Mortar

1. Epoxy mortar shall be of the sanitary type that when set and hardened shall:

a. Be free of any odor.

b. Not be affected by food processing residues, wastes, and bacteria.

c. Meet or exceed ANSI A118.3.

d. Be free of any fillers that may scratch, stain, or damage the natural face finish of the masonry.

e. Consist of two or three component mix of resin, hardener, and powder containing less than 0.1 percent free water and nonpolymerized organic solvent.

f. Match color to masonry unless noted otherwise.

2.2 PROPORTIONING AND STRENGTH

A. Mortar. Type S, Proportion Specification, ASTM C270.

B. Grout. 2000 PSI, Coarse Type, ASTM C476.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Verify that all equipment for mixing mortar is acceptable and in working condition.

2. Verify that water and all other materials required are available and accessible at the mixing area.

3.2 PREPARATION

A. Measurement of Material

1. Method.

a. Mortar Cement and Hydrated Lime. Batched by bag.

b. Sand.

1) Batched by volume in suitably calibrated containers.

2) Provide proper allowance for bulking and consolidations.

3) Provide for weight per cubic foot of contained moisture.

2. Cement Lime Mortar.

a. Type "S" cement-lime mix of the following proportions by volume.

1) Portland Cement. 1 part.

a) White, nonstaining for cut stone and split face masonry.

b) White silica for split face masonry.

2) Hydrated Lime. 1/2 part.

3) Sand. 4 parts.

3. Epoxy Mortar.

a. Shall be sanitary type proportioned by dry volume as per the manufacturer's recommendations.

4. Fine Grout.

a. Provide the following proportions by volume:

4) Portland Cement. 1 part.

5) Hydrated Lime or Lime Putty. 0 to 1/10 part.

6) Aggregate Ratio (Measured in a Damp Loose Condition). Sand; not less than 2 1/4 and not more than three times the sum of the volumes of cement and lime.

5. Coarse Grout.

a. Provide the following proportions by volume:

7) Portland Cement. 1 part.

8) Hydrated Lime. 0 to 1/10 part.

9) Fine Aggregate Ratio (Measured in a Damp Loose Condition). Sand, not less than 2 1/4 and not more than three times the sum of the volumes of cement and lime.

10) Coarse Aggregate Ratio. Not less than one and not more than two times the sum of the volumes of cement and lime

6. Stearate Additive.

a. Limit to 3 percent of the weight of cement.

b. Use only where designated by Contract Documents.

B. Mixing of Materials

1. Mortar.

a. Use dry-mix method.

b. Add cement, sand, and lime.

c. Turn over together the materials for each batch until even in color. Dry materials indicate that cementitious material has been thoroughly distributed throughout.

d. Add water to obtain required plasticity.

e. All cementitious materials and sand shall be mixed a minimum of 5 minutes in a mechanical batch mixer after all materials are in the mixer. Hand mixing shall not be allowed.

f. Waterproofing Admixture. Comply with manufacturer's instructions for all exterior masonry mortar mix.

g. Mortar, except epoxy, may be retempered by adding water and remixing, as required for workability, but not after initial set. Mortar shall be used within a 1-1/2-hour period after the original mixing. Mortar older than 1-1/2 hours shall be discarded.

11) Epoxy mortar shall not be retempered in the mixer at any time and retempering at the board shall be avoided. Antifreeze admixtures will not be permitted.

2. Grout.

a. All cementitious materials and aggregates shall be mixed a minimum of 5 minutes in a mechanical batch mixer after all materials are in the mixer. Hand mixing shall not be allowed.

b. Add only as much water as required for workability.

c. Add waterproofing admixture to comply with manufacturer's instructions for all exterior masonry mortar mix.

d. Mix grout to have a slump between 8 and 10 inches, at time of placement.

3.3 INSTALLATION

A. **Mortar**. See Section 04 20 01, "Masonry, Construction."

B. **Grout**. See Section 04 20 01, "Masonry, Construction."

3.4 FIELD QUALITY CONTROL

A. **Mock-Up Panel**. Each batch of mortar shall be compared to the mock-up panel for consistency of texture, color, and general appearance.

END OF SECTION

SECTION 04 05 23

MASONRY, ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, tools, equipment, and materials necessary to furnish and install the masonry accessories in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ACI - American Concrete Institute.
2. ASTM - American Society for Testing and Materials.

1.4 SUBMITTALS

A. **Product Data**. Provide data for each accessory utilized showing that each complies with the specifications. Include sizes, gauges, materials, and finishes.

B. **Shop Drawings**. Submit layout drawings showing location, size, type, material, and manufacturer as applicable to each type of masonry accessory.

C. **Samples**. Provide one sample of each unit and/or not less than a 1-foot-long section showing all features of that unit.

1.5 JOB CONDITIONS

A. **Dimensions and Quantities**. The Contractor shall verify all measurements and quantities and be responsible for same.

B. **Coordination**. All masonry work shall be coordinated so that all required accessories are available at the start to prevent delays, errors, and/or omissions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver all materials in sealed containers, wrapped bundles and each clearly marked as to type of unit, size, finish, quantity, manufacturer, and model number.

B. **Storage**. Keep masonry accessories off the ground, under cover, and in dry location to prevent damage due to contaminants, corrosion, and other causes.

C. **Handling**. Handle accessories in a manner that minimizes bending, twisting, and other defects that may cause the finish masonry work to be rejected.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. Horizontal Joint Reinforcing

1. Fabrication. Units shall be welded wire prefabricated in straight lengths of not less than 10' 0" with matching "L" corners and "T" or "+" intersection units with two or more side rods of and cross rods welded to side rods at not more than 16 inches on center. Side rods shall be deformed and cross rods plain each not less than 9 gauge meeting ASTM A 82, "Cold-Drawn Steel Wire, Plain, for Concrete Reinforcement."

2. Finish. Reinforcing shall be hot dip galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A 153, "Zinc-Coating (Hot Dip) on Iron and Steel Hardware," Class B-2.

3. Types.

   a. Single-Wythe Walls. Ladder type with two side rods.

   b. Multiple-Wythe Walls. Ladder type with a side rod above each wythe.

   c. Multiple-Wythe Cavity Walls. Ladder type with adjustable double eye and pintle.

B. Wire Ties

1. Fabrication. Two-piece wire and anchor assembly allowing vertical or horizontal adjustment between wall and framework with anchor section for welding to steel.

2. Materials. Wire and anchor to be hot dip galvanized after fabrication. Anchor to be of sufficient length to allow adjustment of tie for one full height of masonry unit being anchored. Wire to be not less than 1/4-inch diameter, triangular shaped, and sized to extend within 1 inch of the masonry face being anchored.

C. Dove Tail Anchor and Tie

1. Dove tail anchor shall be 1 inch wide and 1 inch deep with a 5/8-inch throat. Anchor shall be hot dip galvanized, not less than 22 gauge, and foam filled.

2. Dove tail tie shall be Type 316 stainless steel sized to fit anchor and extend to 1 inch of the face of the masonry unit being anchored. Tie may be flat or triangular.

D. **Strap Anchors**. Strap anchors for cut stone shall be Type 316 stainless steel of the sizes and types recommended by the stone supplier.

E. **Reinforcing Steel**. Reinforcing steel shall be Grade 60 billet steel meeting ASTM A 615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."

F. Compressible Filler

1. Use foamed polyurethane strip saturated with polybutylene waterproofing material.

2. Hydrostatic Resistance.

   a. Six feet of water, when compressed to 50 percent of its original volume.

   b. Ten feet of water, when compressed to 60 percent of its original volume.

3. Maintain resiliency to allow for installation in temperatures as low as 40° Fahrenheit (F).

4. Waterproof when compressed to 50 percent of its original volume in temperatures from -40° F. to 200° F.

5. Elongation. At least 325 percent with a tensile strength of not less than 53 pounds per square inch (psi).

6. No migration of polybutylene compound in the polyurethane strip will be allowed.

G. Premolded Control Joint Strips

1. Solid rubber strips with a Shore A durometer hardness of 60 to 80, designed to fit standard sash block and maintain lateral stability in masonry wall.

2. Size, location, and configuration as shown.

H. Neoprene Expansion Joint Strips

1. Provide bellows type strip made form 1/16-inch cured, calendared neoprene with perforated flanges.

I. **Weep Holes**. 3/8-inch outside diameter by 4 inches long clear plastic tubes filled with nylon rope. Rope shall extend 1/2 inch beyond the outside face of the plastic tube and extend 10 inches into the cavity.

J. **Masonry Vents**. Multicell, flexible ultraviolet resistant polypropylene co-polymer sized to fill head joint and permit moisture to the exterior without permitting insects access to the cavity. Color as selected or to match mortar.

K. Cavity Fill Mesh

1. Provide stainless steel 1/2-inch mesh hardware cloth, backed with asphalt impregnated cloth.

2. Install below all block courses that are to be filled with grout.

L. Through-Wall Flashings

1. Copper Flashing. Copper sheet weighing not less than 3 ounces per square foot.

M. Insulation

1. Rigid Board. Rigid closed cell extruded polystyrene having a 15-year aged "R" value of not less than 5.0 at 75° F. and shall comply with ASTM C 578, "Preformed, Cellular Polystyrene Thermal Insulation," Type VI having a compressive resistance of 40 psi and water absorption not greater than 0.1 percent by volume.

2. Preformed. Specially shaped polystyrene units designed for installation in the cores of concrete block.

3. Adhesive. Type as recommended by insulation board manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General**. See Section 04 20 01, "Masonry Construction."

END OF SECTION

SECTION 04 20 01

MASONRY, CONSTRUCTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, tools, equipment, and materials necessary for masonry construction in accordance with the drawings and as specified herein.

1. This section includes requirements for new masonry construction and for infill construction at existing interior masonry walls.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ASTM - American Society for Testing and Materials.
2. ACI - American Concrete Institute.
3. BIA – The Brick Industry Association.
4. NCMA - National Concrete Masonry Association.
5. UL - Underwriters' Laboratories, Inc.

C. **Mockups**: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Prepare mock-ups not less than 7 days prior to Architect’s viewing.

1. Build mockups for typical exterior wall approximately 48 inches (1200 mm) long by 60 inches (1500 mm) high by full thickness, including face and backup construction, including each type of unit masonry and accessories.

a. Build mockup for each type of exterior wall.

1) Exterior wall with CMU back-up.

2) Exterior wall with steel column back-up.

b. Expansion joint, and Contraction Joint. Include a sealant-filled joint at least 16 inches (400 mm) long in exterior wall mockup.

c. Include lower corner of window opening framed with brick sill unit at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.

d. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).

e. Include sheathing, insulation, sheathing joint-and-penetration treatment, air barrier, veneer anchors, horizontal joint reinforcing, flashing, cavity drainage material, weep holes with masonry vents, grouted masonry cores, and cavity fill mesh.

3) Demonstrate surface penetration, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

f. Include section of back-up construction and air barrier membrane for testing penetrations, and seams for ASTM E 1186 and membrane adhesion per ASTM D 4541.

2. Build mock up for typical interior glazed concrete block wall to be patched and to receive infill construction approximately 32 inches (1200 mm) long by 32 inches (1200 mm) high.

a. Build mock up in existing wall. Approved mockup may become part of the completed work if undisturbed at time of Substantial Completion.

3. Clean one-half of exposed faces of mockups with masonry cleaner.

4. Protect accepted mockups from the elements with weather-resistant membrane.

5. Approval of mockups is for masonry unit selection, color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

c. Approval of mockup is also for final masonry unit selection.

6. Modify mockup, as needed, to address Architect’s written comments. Do not proceed with masonry installation, and DO NOT PLACE ORDER FOR BRICK OR MORTAR until mockup is approved by the Architect.

7. Removal. Retain and protect mock-up during construction as a standard for judging completed masonry work. Do not alter, move, or destroy mock-up until given written permission of the Engineer/Architect. Mock-up of exterior walls hall be removed from the site on completion and acceptance of the project.

D. **Contractor's Qualifications**. Masonry Contractor shall:

1. Have 5 years' experience in masonry work.

2. Have a qualified foreman with at least three projects of similar or equal type of construction.

3. Be acceptable to the Owner.

1.4 SUBMITTALS

A. Construction Methods

1. Cold Weather. Submit procedures evidencing compliance with requirements of BIA Bulletin 1A, "Construction and Protection Recommendations for Cold Weather Masonry Construction," NCMA Tek Note 3-1A, "All-Weather Concrete Masonry Construction," and ACI 530.1, "Specification for Masonry Structures," Article 1.8.C.

2. Hot Weather. Submit procedures evidencing compliance with requirements of BIA bulletins and/or NCMA Tek Note 3-1A, "All-Weather Concrete Masonry Construction," and ACI 530.1, "Specification for Masonry Structures," Article 1.8.D.

B. **Qualifications**. Submit Masonry Contractor's qualifications as called for under Item 1.3 D. of this section. Submit name of foreman and crew complete with job title and years of experience at that position.

1.5 JOB CONDITIONS

A. **Coordination**. All chases, openings, anchors, and appurtenances for other trades shall be accurately located and built in as work progresses. Schedule and coordinate work with all other trades to avoid delays, errors, or omissions.

B. Environmental Conditions

1. Climatic. No masonry work shall be installed during inclement weather or in temperatures below 40 degrees Fahrenheit (° F.) without Engineer/Architect's review and acceptance of provisions to protect the work.

C. **Dimensions**. The Contractor shall verify all measurements and shall be responsible for all dimensions and elevations.

D. Loads

1. Do not apply uniform floor or roof loading for at least 3 days after completing masonry columns or walls.

2. Do not apply concentrated loads for at least 7 days after completing masonry columns or walls.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. All materials shall be delivered in sealed and clearly marked containers, and in an undamaged condition.

B. Storage

1. Keep masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature

changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air dried condition.

2. Store cementitious materials off the ground, under cover, and in dry location.

3. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

4. Store masonry accessories including metal items to prevent corrosion, accumulation of dirt and oil, and staining of masonry.

C. **Handling**. Handle materials in a manner that minimizes chips, cracks, voids, discolorations, or other defects which might be visible or cause staining in finished work.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. Refer to the various sections of the specifications that relate to materials for masonry work.

2.2 GLAZED CONCRETE BLOCK

A. Use salvaged units only. Salvage full size units and special shapes, as required to match existing construction, without defects on face.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Verify areas and conditions under which masonry work is to be installed. Examine built-in conditions and verify locations. Mock-up panel shall be reviewed and accepted by the Owner and/or the Engineer/Architect before ordering brick and mortar.

B. **Corrections**. Do not proceed until all unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Protection**. All areas subject to damage and/or staining from masonry work shall be protected at all times.

B. **Cleaning**. Clean reinforcing of all loose rust, mill scale, earth, ice, or other materials which will reduce bond to the mortar or grout.

C. Wetting of Masonry Units

1. Wet brick having ASTM C 67, "Methods of Sampling and Testing Brick and Structural Clay Tiles," absorption rates greater than 0.025 ounce per inch per minute.

a. Determine absorption by placing 20 drops of water inside a circle the size of a quarter on typical units. If water is absorbed within 1-1/2 minutes, wet brick before laying.

2. Use wetting methods which ensure that each masonry unit is nearly saturated but surface dry when laid.

3. Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units or structural clay facing units.

3.3 INSTALLATION

A. General

1. Thickness.

a. Build walls, floors, and other masonry construction to the full thickness shown.

b. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

2. Chases and Recesses.

a. Build chases and recesses as shown.

b. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

3. Openings.

a. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting of masonry work.

b. After installation of said items, complete masonry work to match work immediately adjacent to openings.

4. Cutting.

a. Cut all masonry units using motor driven saws to provide clean, sharp, unchipped edges.

b. Cut units as required to provide pattern shown and to fit adjoining work neatly.

c. Use full size units without cutting wherever possible.

B. Interface with Other Work

1. Coordination. Coordinate the installation of masonry with all associated items including flashing, insulation, inserts, ties, anchors, reinforcing, and embedded items.

2. Matching Existing Masonry Work. Match coursing, pattern bond, color, and texture of new masonry work with existing work.

C. Laying Masonry Walls

1. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement type joints, returns, and offsets. Avoid the use of less than half size units at corners, jambs, and where possible at other locations.

2. Lay up walls plumb and true to comply with specified construction tolerances, with courses level, accurately spaced, and coordinated with other work.

3. Fill openings left in masonry by keying every course with all exposed surfaces flush and all joints kept on line, unless otherwise shown.

4. Bond Pattern for Exposed Masonry. Lay exposed masonry in the bond pattern shown or called for, or if not shown or called for, in running bond with vertical joint in each course centered on units in courses above and below. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal one half the horizontal face dimensions at corners or jambs.

5. Exposed face shells that are broken, cracked, defective, or warped shall not be used and if utilized shall be removed and replaced.

6. Stopping and Resuming Work. In each course, rack unit one-half its length for running bond, do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.

    a. Grouting. Except at top of walls when grouting is to be stopped for 1 hour or longer, the top of the lift shall be 1-1/2 inches below the top of the upper most unit grouted.

7. Horizontal reinforcement shall be set in a fully uninterrupted bed of grout.

8. Apply mortar to masonry units so that mortar protruding into cells to be filled with grout is minimized. Mortar that protrudes into cells shall be parged to the masonry units.

9. Built-in Work. As construction progresses, build in items that are specified under this and other sections of the specifications. Fill in solidly with masonry around built-in items.

    a. Set embedded items accurately with templates or accepted means to prevent movement.

    b. Fill space between hollow metal frames and masonry solidly with mortar.

    c. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of hot dip galvanized metal lath in the joint below and rod mortar or grout into core.

10. Provide solid units or fill cores in hollow masonry units with grout not less than 24 inches under bearing plates, beams, lintels, posts, and similar items, and for a width of 24 inches each side of centerline of bearing, unless otherwise indicated.

11. Non-Load-Bearing Interior Walls.

    a. Build full height of story to underside of structure above, unless otherwise shown. Provide lateral support to structure.

    b. Insert compressible filler in all horizontal and vertical joints where masonry terminates.

        4) Insert filler 3/4 inches from both faces of masonry.

        5) Use filler twice as thick as the widest part of the joint.

        6) Thickness of filler shall be a minimum of 1.5 times the compressed thickness.

7) Compress filler to less than thickness of joint and insert.

8) At splices, overlap strips by 3 inches and compress ends to form tight joint.

D. Mortar Bedding and Jointing

1. Solid Units.

a. Lay solid masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place.

b. Do not slush head joints.

2. Hollow Units.

a. Lay hollow masonry units with full mortar coverage on horizontal and vertical face shells.

b. Set webs in full bed of mortar in starting course of piers, columns, and pilasters, and adjacent to cells or cavities to be reinforced or filled with concrete or grout.

3. Tooling/Joints.

a. Unless otherwise noted, joints shall be approximately 3/8 inch. Joints shall be uniform throughout.

b. Tool all joints slightly concave except for surfaces to receive fluid applied membrane air barrier where joints should be struck flush.

E. Horizontal Joint Reinforcement

1. General. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 12 inches.

a. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

2. Metal Ties.

a. Use individual metal ties and shots embedded in concrete and horizontal joints of masonry to tie masonry to concrete.

b. Provide ties as shown, but not less than one metal tie for 3 square feet of wall area spaced not to exceed 24 inches on center horizontally and 16 inches on center vertically.

c. Stagger ties in alternate courses.

d. Provide additional ties within 12 inches of all openings and space not more than 3'-0" apart around perimeter of openings.

3. Ladder-Type Reinforcing.

a. All masonry walls or partitions shall have hot dip galvanized horizontal reinforcing.

b. All cavity walls shall be reinforced with ladder type double eye and pintle reinforcing.

c. All interior and noncavity walls shall be reinforced with ladder type reinforcing.

d. Use continuous reinforcing embedded in horizontal mortar joints for bond tie between wythes and as shown.

e. Install at not more than 16 inches on center vertically for walls.

4. Corners.

a. Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

b. For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.

5. Openings.

a. Reinforce masonry openings greater than 12 inches wide, with additional horizontal joint reinforcing placed so that three horizontal joints approximately 8 inches apart, immediately above the lintel and immediately below the sill are reinforced.

b. Extend additional reinforcing a minimum of 24 inches beyond jambs of the opening, except at control or expansion joints.

c. In addition to wall reinforcing, provide additional reinforcing at opening as required.

F. Vertical Reinforcing

1. Position reinforcing accurately. Support and secure vertical bars against displacement prior to grouting. Where vertical bars are shown in proximity, provide a clear distance between bars of not less than the normal bar diameter or 1 inch, whichever is greater. This also applies to contact lap splices and adjacent splices or bars.

a. At columns, piers, and pilasters, provide a clear distance between vertical bars as shown, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater. Provide lateral ties.

2. Splice reinforcing bars where shown or specified; do not splice at other points unless acceptable to the Engineer/Architect.

a. Provide minimum lap as shown on drawings or if not shown on drawings, as required by "Building Code Requirements for Concrete Masonry Structures" ACI Committee 530.

G. Grouting

1. Materials.

a. Fine Grout. Use fine grout for filling spaces less than 4 inches in both horizontal dimensions.

b. Coarse Grout. Use coarse grout for filling spaces 4 inches or larger in both horizontal dimensions.

2. Preparation.

a. Debris. Construct grout spaces free of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

b. Cleanouts. Provide cleanouts in the bottom course of masonry for each grout pour when the grout pour height exceeds 5 feet.

1) Construct cleanouts adjacent to each vertical bar. In solid grouted masonry, space cleanouts horizontally a maximum of 32 inches on center.

2) Construct cleanouts with an opening of sufficient size to permit removal of debris. The minimum opening dimensions shall be 3 inches.

3) After cleaning, close cleanouts with closures braced to resist grout pressure.

3. Placing.

a. Place grout using spout or chute. Place continuously: do not interrupt placing operation for more than 1 hour. Terminate grout placements 1-1/2 inches below top course of placement.

b. Grout pour and lift heights shall not exceed heights specified in ACI 530.1.

c. Bond Beams and Slab Bearing. Stop grout in vertical cells 1-1/2 inches below bond beam course or slab. Place horizontal reinforcing in bond beam; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

d. Consolidation. Consolidate grout at the time of placement.

4) Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.

5) Consolidate pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement have occurred.

H. Lintels

1. Install anchor bolts, base plates, and steel lintels of size and shape shown. Materials are specified and furnished under Division 5.

2. Provide precast or formed-in-place masonry lintels where shown and where openings of 16 inches or more are shown without structural steel lintels.

a. Thoroughly cure precast lintels before handling and installation.

b. Temporarily support formed-in-place lintels.

c. Unless otherwise shown, provide one horizontal reinforcing bar top and bottom for each 4 inches of lintel thickness.

3. For hollow masonry unit walls, unless otherwise shown, use specially formed "U" shaped masonry lintel units with reinforcing bars placed as shown, filled with grout.

4. Provide minimum bearing at each jamb of not less than 8 inches unless shown otherwise. Set edge of steel lintels back 1/2 inch from exposed faces of masonry.

I. Flashing of Masonry Work

1. Provide concealed flashings in masonry work as shown.

2. Prepare masonry surfaces smooth and free from projections which might puncture flashing.

3. Place through wall flashing on bed of mortar and cover with mortar.

4. Seal flashing penetrations with mastic before covering with mortar.

5. Terminate flashing 1/2 inch beyond face of wall, unless otherwise shown.

6. Extend flashings to edge of lintels and sills and turn up edge on sides to form pan to direct moisture to exterior.

7. Interlock end joints of deformed metal flashings by overlapping deformations not less than 4 inches and seal lap with elastic sealant.

8. Install all flashings in accordance with manufacturer's instructions.

9. Provide weep holes in the head joints of the first course of masonry immediately above concealed flashings. Space weeps 1'-4" on center, unless otherwise shown.

10. Install reglets and nailers for flashing and other related work where shown to be built into masonry work.

11. Install flashing at the base of all exterior masonry wall sections, at all sills, and above all exterior masonry openings. Extend flashing above the supporting member as shown.

J. Insulation

1. Rigid Board Insulation.

a. Install small pads of adhesive spaced approximately 1'-0" o.c. both ways on inside face or attached to inside face with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against wythe of masonry or other construction as shown.

1) Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

2) Isolate insulation from any and all heating ducts and/or vents passing through with noncombustible material having limited heat conductance.

K. Control and Expansion Joints

1. Provide vertical expansion, control, and isolation joints in masonry where shown or specified.

2. Build in related items as the masonry work progresses.

3. Rake out mortar in preparation for application of caulking and sealants.

4. Elastic Expansion Joint Strips. Where shown or specified, build flanges of factory fabricated expansion joint strips into masonry.

5. Compressible Fillers.

   a. Build in compressible fillers for all expansion and control joints and where shown for all vertical and horizontal joints at tops of walls.

   b. Install in accordance with manufacturer's written instructions.

6. Control/Expansion Joint Spacing.

   a. Where location of control joints is not shown, place 3/8 inch vertical joints spaced:

      1) Exterior brick, 20'-0" on center.

      2) Interior and exterior masonry 24'-0" on center.

   b. Locate control joints at points of natural weakness in the masonry work including the following:

      1) At structural columns.

      2) Above expansion joints in the supporting structure.

      3) At vertical chases, recesses, and other points of reduction in wall thickness.

      4) At locations where masonry wall height changes.

      5) Where masonry abuts supporting structure. At one side of openings less than 6 feet in width and at both sides for openings greater than or equal to 6 feet in width.

      6) At a distance equal to one-half the wall height from corners or intersections with other masonry.

      7) Submit joint locations for review.

   c. Control joints in exterior masonry of cavity walls shall be staggered from interior masonry control joints.

L. Weep Holes

1. Location. Exterior wythe of cavity walls at foundation course, ledges, flashings, and where noted.

2. Spacing. Set weep vents every 24" on center in alternate rows. Set one row in the bed joint with the alternate row 3 inches above the bed joint.

M. Protection

1. At the close of each working day, the open top and ends of all masonry work shall be protected and kept dry by a weighted waterproof covering which overhangs the walls by a minimum of 2 feet.

2. No masonry work shall be installed during inclement weather or in temperatures below 40 degrees Fahrenheit (^{o} F.) without Engineer/Architect accepted provisions to protect the work.

3. After installation, all masonry work shall be kept from freezing during cold weather for not less than 48 hours.

4. All masonry shall be adequately braced for wind until the roof deck is applied and anchored.

5. Any masonry damaged by the elements shall be replaced at no additional cost to the Owner.

3.4 REPAIR AND RESTORATION

A. Repair

1. Remove and replace masonry units which are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units.

2. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing

1. During the tooling of joints, enlarge any voids or holes, except weep holes or vents, and completely fill with mortar.

2. Point up all joints at corners, openings, and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking and sealant compounds.

3. Existing Work. Where shown on the drawings, existing masonry shall be pointed. Joints shall be cleaned of existing mortar to a depth not less than 1 inch from the face of the masonry. Disintegrated joints shall be cut out to the full depth of the disintegration. Joints shall be brushed and blown clean with air under pressure and pointed to the full depth of the cut. Cuts greater than 1 inch deep shall be stage pointed. Joints shall be kept wet while pointing.

3.5 FIELD QUALITY CONTROL

A. **Conformance.** All work will be reviewed for conformance to work and material utilized in the accepted mock-up panel specified in paragraph 1.3 C. of this section. All work and/or materials found not in conformance shall be removed and replaced.

3.6 CLEANING

A. **Unglazed Masonry**. Contractor shall clean exposed, unglazed masonry surface to the satisfaction of the Engineer/Architect.

1. Wipe off excess mortar as the work progresses. Dry brush at the end of each day's work.

2. Sample. After mortar is thoroughly set and cured, clean approximately 20 square feet of wall area as described. Obtain acceptance of the Engineer/Architect.

3. Final Cleaning.

   a. Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if required.

   b. Presoak wall by saturating with water and flush off loose mortar and dirt.

   c. Scrub down wall with stiff fiber brush and a solution of 1/2 cup of trisodium phosphate and 1/2 cup of household detergent dissolved in 1 gallon of water.

   d. Rinse walls, using clean, pressurized water, to neutralize cleaning solution and remove loose material.

4. Acid Cleaning. Use acid cleaning upon acceptance of unit masonry manufacturer and Engineer/Architect when cleaning as outlined above is insufficient.

   a. Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if required.

   b. Presoak wall by saturating with water and flush off loose mortar and dirt.

   c. Comply with the requirements and recommendations for "Cleaning Clay Products Masonry" of the Technical Notes on Brick and Tile Construction by BIA for the type of masonry and conditions involved in the work.

   d. Apply acid type cleaners in compliance with manufacturer's instructions.

   e. Protect other work from acid solutions and cleaning operations.

B. **Glazed Concrete Block**. Use job-mixed detergent for all exposed existing glazed concrete block after all masonry construction and repairs are complete.

3.7 DEMONSTRATION

A. **Visual**. The Contractor, Owner, and Engineer/Architect will visually review the masonry work for completion. The Contractor will demonstrate that all masonry materials, dimensions, built-in items, and openings are in conformance with the Contract Documents. All joints are tooled and uniform in appearance.

B. **Final Acceptance**. The visual demonstration for completion of the masonry work shall not be considered as a final acceptance of work. All and any discrepancies "punch listed" at final inspection shall be corrected by the Contractor to the satisfaction of the Engineer/Architect and Owner.

3.8 **PROTECTION**. Protect the masonry work from deterioration, discoloration, or damage during subsequent construction operations. Remove any and all protection at the completion of the project.

END OF SECTION

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SECTION 04 21 13

MASONRY, BRICK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, tools, equipment, and materials necessary to furnish and install the brick masonry in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ACI - American Concrete Institute.
2. ASTM - American Society for Testing and Materials.
3. BIA - Brick Institute of America.

C. **Source**. Obtain brick from one manufacturer for uniform texture and color or if blended of uniform blend.

1.4 SUBMITTALS

A. **Product Data**. Provide data for each different masonry unit showing that materials comply with specifications. Include size variation data verifying that actual range of sizes for brick falls within dimension tolerances of ASTM C 216, "Facing Brick (Solid Masonry Units Made From Clay or Shale)," where modular dimensioning is indicated.

B. **Samples**. Submit four of each type of brick selected showing the range of color, texture, and dimensions to be expected in the completed construction.

C. **Certifications**. Submit copies of manufacturer's certification that each type of brick selected complies with the specified requirement.

1.5 JOB CONDITIONS

A. **Blending**. When factory blend is not adequate, Contractor shall field blend brick as required to obtain the desired results or a match to existing.

B. **Selecting**. Where stack bond and/or select color is called for, the Contractor shall hand select brick for uniformity of size and/or color, keep isolated, and clearly mark pallets.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver brick in original packages and on pallets, undamaged and plainly marked as to manufacturer and material.

B. **Storage**. Brick shall be stored on pallets off the ground, covered and kept dry to prevent damage and/or staining.

C. **Handling**. Handle brick as recommended by the manufacturer.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. **Modular Size Brick**. Provide standard size brick, 7 5/8 inches long by 2 1/4 inches high by 3 5/8 inches wide, actual size for exposed vertical brick when laid on a stretcher. Provide special molded shapes where shown and for applications which cannot be made from standard brick.

B. **Cored Brick**. Provide solid or cored brick for vertical brickwork. Do not use cored brick with net cross sectional area less than 75 percent of gross area in the same plane or with core holes less than 3/4 inch from any edge.

C. **Solid Facing Brick**. ASTM C 216, "Facing Brick (Solid Masonry Units Made From Clay or Shale)," Grade SW, Type FBX or FBS.

D. **Brick Strength**. F'm = 2400 PSI.

2.2 BRICK ALLOWANCE

A. **Measurement**. The individual wall area of the various grades and types of bricks as determined from field measurement of masonry work shall include all specials, stretchers, soldiers, rowlocks, bullnose, and all shapes incorporated in the finished work. For final payment purposes, the completed and accepted masonry work will be measured and the number of various brick units determined on a square foot of single wall basis, not including openings, as follows:

Joint Width	No. of 2-1/4" by 7-5/8" Brick/square foot
3/8 inch	6.75

B. **Bid Allowance**. For the purpose of preparing a bid, the Contractor shall allow a material price of $650.00 per 1,000 bricks for delivery and unloading at the job site. The bid allowance shall be adjusted for final payment by the following items:

1. The cost of the brick selected by the Owner.
2. The number of bricks incorporated in the work.
3. An allowance for actual rejects and breakage of brick, not to exceed 2 percent of the number of bricks incorporated in the work.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General**. See Section 04 20 01, "Masonry, Construction."

END OF SECTION

SECTION 04 22 00

MASONRY, CONCRETE BLOCK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, tools, equipment, and materials necessary to furnish and install the concrete block masonry in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ACI - American Concrete Institute
2. ASTM - American Society for Testing and Materials.
3. NCMA - National Concrete Masonry Association.

C. **Source**. Obtain block from one manufacturer with uniform texture and color.

D. **Manufacturer's Qualifications**. Manufacturer shall be a member in good standing of the National Concrete Masonry Association and manufacturing concrete masonry units for not less than 10 years.

1.4 SUBMITTALS

A. **Product Data**. Provide data for each different masonry unit showing that materials comply with specifications. Include size and strength variation data verifying that actual range of sizes and strength for block falls within tolerances required under ACI 530.1

B. Samples

1. Submit one of each type of block showing the range of color, texture, and dimensions to be expected in completed construction.

C. **Certifications**. Submit copies of manufacturer's certification that each type of masonry unit required complies with the specified requirement.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver all masonry units on pallets, separated as to size, type, and manufacturer, and clearly marked.

B. **Storage**. Store all units off the ground, covered and protected to keep dry and prevent staining and/or damage.

C. **Handling**. Handle to prevent marring or chipping of the face and/or edges, or damage to any insert.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Masonry Units

1. General. All concrete block shall be normal weight, Type 1, thoroughly cured, made from Portland cement, limestone, or natural sand, gravel, or crushed stone. All units shall be square, true, and have sharp arises and dimensionally stable.

2. Standard Block. Unless otherwise shown, all concrete units shall be standard block, load bearing, two core conforming to ASTM C 90, "Load Bearing Concrete Masonry Units" and solid units conforming to ASTM C 90 except block shall be 100 percent solid.

3. Concrete Block Strength. Minimum net area compressive strength: 2,8000 PSI (f'm = 2,000 PSI)

4. Shadow Block. Shadow block shall be solid or two-core, load bearing, conforming to ASTM C 90 and of the configuration shown.

5. Precast Lintels. Precast concrete lintels shall be of the sizes shown, with not less than two Number 5 reinforcing bars (one top, one bottom) for each 4 inches of lintel width.

6. Specials. Specials such as sash blocks, corner blocks, bond beam blocks, cove blocks, grout blocks, etc., shall match the adjoining masonry units in color, texture, and finish unless noted otherwise.

B. Insulated Concrete Masonry Units

1. General. Units shall be 4 inches high by 16 inches long by 12 inches wide, or as otherwise shown on the drawings.

2. Basis of Design: Concrete Products Group, Spek-Brik, or approved equal. Color to be selected by the architect or owner.

C. Integrally Pigmented Load Bearing Units

1. General. Stretcher units to be 4 inches high by 16 inches long, widths as indicated on drawings. Units to be normal weight load bearing two-core, conforming to ASTM C90.

2. Units to have integral metallic oxide pigments and integral polymer water repellent.

3. Provide special units, as indicated on drawings, for bond beams, control and expansion joints, and lintels.

4. Color to be selected from manufacturers' standard blends. Exposed faces shall be uniform and provide the appearance of brick construction.

5. Manufacturers:

a. Old Castle “Quick-Brik.”

b. Sealtech Block “Sealbrick.”

c. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General**. See Section 04 20 01, "Masonry, Construction."

END OF SECTION

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SECTION 05 00 00

GRATING AND MISCELLANEOUS METALS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the miscellaneous metals in accordance with the drawings and the specifications. This specification does not include other division 5 specification, including Fixed metal ladders (05 51 10), Structural Steel (05 10 00), pipe tube and railings (05 52 13) and others.

1.3 QUALITY ASSURANCE

A. **Fabricator Qualifications**. Fabrication shall meet requirements of the American Institute of Steel Construction (AISC) standards.

B. **Standards**. Ensure that materials and workmanship are in accordance with the following standards referenced herein.

1. AASHTO – American Association of State Highway and Transportation Officials.
2. AISC.
3. ASTM – American Society for Testing and Materials.
4. AWS – American Welding Society.
5. OSHA – Occupational Safety and Health Administration.

1.4 SUBMITTALS

A. **Submit the following** in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Shop Drawings and Product Data

1. Schedule. No products shall be delivered or installed before this submittal package has been reviewed and approved.
2. Submittal Package Contents.
    a. Manufacturer's name and model numbers.
    b. Manufacturer's standard product data and equipment specifications.
    c. Materials of construction.
    d. Dimensional layouts and required clearances.
    e. Connections including welding.
    f. Weights.

g. Anchors.

h. Bill of material.

i. Coatings.

j. Complete description in sufficient detail to permit an item by item comparison with the specifications.

k. Manufacturer's instructions.

l. Warranties.

1.5 JOB CONDITIONS

A. **Field-verify all dimensions, locations, and elevations** of anchors, bolts, plates, openings, and other miscellaneous metal items and be responsible for their proper fit.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **In accordance with Section** 01 60 00 "Materials and Equipment" and the manufacturer's instructions.

1.7 SPECIAL WARRANTY

A. Not used.

PART 2 PRODUCTS

2.1 GENERAL

A. Design

1. Proportion components not sized on the plans to provide ample strength and stiffness for the loads expected.

2. All steel shall meet the requirements of ASTM A 36.

3. All cast iron shall meet the requirements of ASTM A 48.

B. **Fabrication**. Fabricate the miscellaneous metals in accordance with the approved shop drawings.

2.2 EQUIPMENT

A. Chains

1. Multiple row of 1/4 inch, Type 304 all-welded stainless steel.

2. Type 316 stainless steel swivel safety snap at each end.

3. Type 316 stainless steel eye bolt to the railing or wall.

B. Gratings

1. Aluminum.

a. Type 6063 aluminum, rectangular pressure lock type with cross bars flush with the walking surface.

b. Bearing bars shall be not less than 3/16 inch thick with a minimum depth of 1-1/4 inches and spaced not greater than 1-3/16 inches on center.

c. Cross bars shall be 3/4 inch x 1/8 inch spaced 4 inches on center.

2. Design Loading.

a. Uniform load of 300 pounds per square foot with a deflection of not more than 1/160 of the span, unless otherwise shown.

b. Depths noted are minimum; increase depth of grating and support angle as required to meet design loading.

c. Uniform depth in any one area.

3. Supports.

a. Support gratings on all four sides by an angle of the same material as the grating.

b. Securely anchor angle supports.

c. Where the support angle extends across an opening, supplement the support angle with a structural channel.

d. Channel, unless noted otherwise, shall be of the same material as the grating and not less than 3 inches in depth.

4. Banding. Band edges and openings in the gratings with a bar equal to the bearing bar. Provide 1/8 inch thick cover plate with pegs to prevent movement for each opening.

5. Setting.

a. Set gratings flush with the finished surface.

b. Secure gratings to their supports by removable anchors.

c. Set anchors every 4 feet 0 inches on center but not less than two anchors per each section of grating.

d. Clip gratings with a span over 4 feet together.

C. Planking

1. Materials. Type 6063-T6 aluminum, unpunched, solid surface with horizontal ribbing.

2. Design Loading. Design planking for a uniform load of 300 pounds per square foot with a deflection of not more than 1/160 of the span, unless otherwise shown.

3. Supports.

a. Support planking on all four sides by an angle of the same material as the planking.

b. Securely anchor angle supports.

c. Where the support angle extends across an opening, supplement the support angle with a structural channel.

d. Channel, unless noted otherwise, shall be of the same material as the planking and not less than 3 inches in depth.

4. Banding. Band edges and openings in planking with a bar equal to the bearing bar. Provide 1/8 inch thick cover plate with pegs to prevent movement for each opening.

5. Setting. Planking shall be set flush with the finished surface, and the planking shall be of uniform depth in any one area.

6. Subject to compliance with the specifications, provide the planking from one of the following approved manufacturers.

    a. IKG Borden HD Style P.

    b. Or equal.

D. **Floor Plate Covers**. Conform to ASTM A 786 made of A283 Grade D or A36 steel.

E. Structural Shapes

1. Structural shapes including all lintels shall be ASTM A 36 steel, hot-dipped galvanized, unless noted otherwise.

2. Lintels. Minimum 8 inch bearing on each side of the opening, unless noted otherwise.

3. Other. All structural shapes other than lintels shall be as required to complete the work. All anchors, connections, bearing plates, and fabrication details shall be standard, unless otherwise noted.

F. Stairs

1. All stair treads, stringers, railings, angles, landings, anchors, clips, and supports as shown.

2. Designed to meet local, state, and OSHA requirements with a safety factor of 4.

3. Weld bent stringers to develop strength of section.

4. Continuously weld 3/16 inch closure plate to exposed ends of stringers.

G. Flumes, Baffles, and Weirs

1. Flumes, baffles, and weirs shall be of the size, shape, and material shown.

2. Weld and grind smooth all joints.

3. Provide watertight expansion joints as shown.

H. Weir Plates, Stop Plates, and Guide Frames

1. Unless drawing references Section 13 00 40, fabricate all weir plates, stop plates, and guide frames aluminum alloy 6061-T6 or equivalent, with mill finish, of the sizes and shapes shown.

2. Guide frames shall be straight and true, extruded construction, with all corners mitered, welded, and ground smooth.

3. Fit guide frames with ultra high molecular weight polyethylene seals at all points of contact.

4. Continuously secure seals with dovetail or dado joint.

5. Guide frame shall weigh a minimum of 1.5 pounds per foot.

6. Stiffen plates with structural shapes, welded in place, as required to keep the maximum deflection below 1/360 of the span under the loads developed from maximum head conditions.

7. Plates and frames shall be by the same manufacturer.

I. **Staff Gauges**. Staff gauges shall be Type 6061-T6 aluminum as shown. Numbers shall be Futura Style, 1-1/2 inches high.

J. Fasteners for aluminum or stainless steel shall be Type 316 stainless steel.

K. **Anchor Bolts**. In accordance with Section 05 05 23 "Anchors."

L. **Ladders**. Ladders as shown with all anchors, bolts, and necessary appurtenances. Weld and grind smooth all joints.

M. Stair Nosings

1. Provide all concrete stairs with antislip stair nosings.

2. Stair nosings shall be extruded aluminum with four alternating ribs of abrasive grit.

3. Abrasive grit shall be not less than 19 ounces of aluminum oxide per square foot of nosing.

N. Stair Treads

1. Grating Type. Galvanized steel with 1-1/4 inch x 3/16 inch bearing bars at 1-3/16 inches on center with nonskid nosing.

2. Concrete-Filled Steel Pan. 14 gauge steel continuously welded to stringers.

O. Covers and Frames

1. Access Openings. Covers and frames for access openings shall be cast iron or mill-finish aluminum of the size, type, and style as shown. All hardware for aluminum access doors shall be Type 316 stainless steel.

2. Pipe Openings. Covers and frames for pipe openings shall be 1/4 inch aluminum plate set in an aluminum bar frame.Covers shall be split ring type for installed pipe and solid for openings of future pipe.

3. Expansion Joints.

a. Flush Type. Cover and frame for expansion joints shall be flush type, extruded aluminum frame with 1/4 inch aluminum cover plate and neoprene insert.

b. Surface Type. Cover for expansion joints shall be preformed aluminum shapes with tapered edges, anchored on one side only. Anchors shall be stainless steel, flat head type, set flush, 12 inches on center.

P. Access Steps

1. Steps shall conform to the requirements of ASTM C 478, AASHTO M-199, and as shown.

2. Each step shall consist of a 1/2 inch Grade 60 deformed reinforcing bar encapsulated in polypropylene.

   a. The polypropylene shall conform to ASTM D 4101.

   b. The reinforcing bar shall conform to ASTM A 615.

3. Do not exceed 24 inches between the top of opening and the first step.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Take field measurements** prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

3.2 PREPARATION

A. **Coordinate and furnish anchorages**, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor rods, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.3 GENERAL

A. Fasteners

1. Conceal fasteners where practical.

2. Countersink all bolts, properly sized, and of proper length to permit full thread in the nut and project not more than a 1/4 inch beyond the nut.

3. Provide lock washers at all nuts and nick the bolt to prevent loosening.

4. All welds shall be smooth and regular, solid, and homogeneous throughout and free from pits, slag, scale, and other defects.

5. Make joints exposed to weather watertight with gaskets or continuous welding.

6. Grind smooth all welds in exposed finished work.

B. **Holes**. Drill or punch all holes with clean, true lines and surfaces.

C. Welding

1. Unless otherwise shown, all welding shall be continuous along all adjoining planes and shall produce a neat, even finish and smooth appearance.

2. Conform to welding requirements of AWS.

3. For all welding of aluminum use inert-gas shielded-arc method conforming to AWS D1.2.

4. Weld stainless steel conforming to materials and procedures set forth in "The Procedure Handbook of Arch Welding" by Lincoln Electric Co. or other approved procedures.

D. Galvanizing

1. Where galvanized or zinc coated is called for, it shall be hot dipped after fabrication in accordance with the standard specifications of the Hot Dip Galvanizers Association.

2. Do not paint galvanized metal, unless otherwise noted.

3. Coat all abraded areas, welds, or holes drilled in the field with a zinc-rich paint.

E. **Painting**. Unless otherwise noted, see Section 09 90 00 "Painting," for miscellaneous metal coating.

F. **Anchors**. Coat all ferrous anchors that are not galvanized with an asphaltic paint prior to installation.

G. **Aluminum**. Isolate all aluminum in contact with concrete, masonry, or dissimilar metals by coating the contact surfaces with a two-part water-based, gray epoxy primer.

3.4 INSTALLATION

A. **Fabricate and install** the miscellaneous metals specified herein as shown and in accordance with approved shop drawings and the manufacturer's recommendations.

END OF SECTION

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SECTION 05 05 14

GALVANIZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section. This section sets forth requirements for the performance of the galvanizing process where galvanizing is called for under this Contract. Wherever a part, fabrication, assembly, or other item is noted to be "galvanized" or "hot-dip galvanized" anywhere in the Contract Documents, this section shall govern, unless other requirements are specifically noted.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, materials, tools, and equipment necessary to hot dip galvanize all items, parts, fabrications, and equipment required to be galvanized by this Contract. The scope of items included by this section shall be any item in this Contract which is noted to be galvanized or hot dip galvanized on the drawings or specifications or items which are supplied galvanized as a standard by any supplier. It shall be understood that this section governs such galvanizing as described in paragraph 1.1 whether or not this section is specifically mentioned or noted where the galvanizing is noted or specified.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in conformance with the following standards as referenced herein:

1. AHDGA - American Hot Dip Galvanizers Association.
2. RCSC - Research Council on Structural Connections of the Engineering Foundation.
3. ASTM - American Society for Testing and Materials.
4. FS - Federal Specifications (DOD & MIL).

C. **Qualifications**. See paragraph 2.3.A.

1.4 SUBMITTALS

A. Certification of Compliance

1. The Contractor shall submit Certification of Compliance that the galvanizing has been performed in accordance with this section. Certification shall include the information specified in paragraph 2.3 C.

B. Galvanizing Plan

1. Prior to proceeding with any galvanizing under this Contract, the Contractor shall submit a Galvanizing Plan for review. Such Galvanizing Plan shall include as a minimum:

a. Name, location, and description of the galvanizing plant to be used along with any descriptive literature available from such plant.

b. Description of the facilities within the plant and how those facilities will be used for the galvanizing called for herein.

c. Description of the plant's quality control program.

C. Qualifications of the Galvanizer

1. The Contractor shall submit all other information necessary as proof that the qualifications of the galvanizer are as specified in paragraph 2.3.A.

1.5 JOB CONDITIONS

A. **Coordination - Interfacing.** Coordinate with all other trades to prevent delays, errors, or omissions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. See paragraph 3.1.

1.7 SPECIAL WARRANTY (Not Used)

1.8 DEFINITIONS

Term used in Contract Documents	**Definition to be used for this Contract**
Hot-Dip Galvanized	ASTM A123
Dip Galvanized	ASTM A123
Lot	ASTM A123
Galvanizer	Company Employed by Contractor performing galvanizing work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel Materials

1. Material for galvanizing shall be geometrically suitable for galvanizing as described in ASTM A 384 and A 385. Steel materials suitable for galvanizing include structural shapes, pipe, sheet, fabrications, and assemblies.

2. Steel material shall be chemically suitable for galvanizing.

a. Recommended steel materials for hot dip galvanizing include, but are not limited to:

1) Structural Shapes and Plates. ASTM A 36, A 242 Type 2, A 283, A 500, A 501, A 529, A 572, A 588, and A 992.

2) Steel for Fasteners.

Category	Bolt Material	Nut Material
Carbon Steel	ASTM A301 GR A or B	ASTM A563 Gr A
High Strength	ASTM A325 Type 1 or 2 ASTM A490	ASTM A563 Gr DH or ASTM A194 Gr 2H
Tower Bolts	ASTM A384	ASTM A563 Gr A
Quenched & Tempered Carbon Steel Bolts	ASTM 449	ASTM A563 Gr C
Quenched & Tempered Alloy Steel Bolts	ASTM A354 Gr BC	ASTM A563 Gr DH

B. Pregalvanizing Fabrication Requirements

1. Fabricate structural steel in accordance with Class I guidelines as described in AHDGA's Recommended Details for Galvanized Structures (MA-11).

2. Fabrication practices for products shall be in accordance with the applicable portions of ASTM A 143, A 384, and A 385, except as specified herein. Avoid fabrication techniques which could cause distortion or embrittlement of the steel.

3. Consult with hot dip galvanizer regarding potential warpage problems or potential handling problems during the galvanizing process which may require modification of design before fabrication proceeds.

4. Remove all welding slag and burrs prior to delivery for galvanizing.

5. Provide holes and/or lifting lugs to facilitate handling during the galvanizing process at positions as agreed among the designer, fabricator, and galvanizer.

6. Avoid unsuitable marking paints. Consult with galvanizer about removal of grease, oil, paint, and other deleterious material prior to fabrication.

7. Remove by blast cleaning or other suitable methods, surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation.

2.2 GALVANIZING

A. **General**. All galvanizing shall be by the hot-dip process; no electrogalvanizing, plating, or thermal spray will be allowed.

B. **Zinc**. Zinc for galvanizing shall conform to ASTM B 6, Prime Western grade.

C. Galvanizing

1. Surface Preparation.

a. Pre-clean steelwork utilizing 10 percent sulphuric acid pickle and flux at 160 degrees Fahrenheit (° F.)

2. Application of Coating.

a. Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A 123. Kettle temperature shall be 850° F.

b. Galvanize bolts, nuts, and washers and iron and steel hardware components in accordance with ASTM A 153. Kettle temperature shall be 1000° F.

c. Use the "dry" galvanizing process.

d. Safeguard products against steel embrittlement in conformance with ASTM A 143.

e. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

3. Coating Requirements.

a. Coating Weight. Shall conform with Table 1 of ASTM A 123 or ASTM A 153, as appropriate.

b. Surface Finish. Shall be continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the end use of the coated article.

c. Adhesion. Shall withstand normal handling consistent with the nature and thickness of the coating and the normal use of the article.

4. Postgalvanizing Treatments.

a. Passivation shall be applied to all galvanized products which will not be painted. Galvanizer shall verify that product will not be painted before applying passivator.

b. Do not treat freshly galvanized or passivated surfaces with oils, grease, or chemicals which might interfere with adhesion of subsequent paint primers and coatings.

c. Where slip factors are required to enable friction grip bolting, these shall be obtained after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the Specification for Structural Joints Using ASTM A 325 or A 490 bolts as approved by the Research Council on Structural Connections of the Engineering Foundation.

5. Bolts and Nuts.

a. Galvanize bolts in standard condition as fabricated.

b. Galvanize nuts prior to tapping; then tap oversize to allow for zinc thickness on the bolts.

2.3 SOURCE QUALITY CONTROL

A. Qualifications of the Galvanizer

1. Must have at least 3 years' experience with hot-dip galvanizing to ASTM standards.

2. Must have at least two zinc kettles, one for 850 ° F. temperature and one for 1000° F. temperature.

3. Must have a heated sulfuric acid tank and a passivation dip tank.

4. Must have facilities for weighing large and small parts.

B. **Factory Inspection and Tests**. Inspections, tests, and samples shall conform with ASTM Specifications and Standards. Inspection shall be carried out by the Contractor at the galvanizer's plant. Inspection rights and privileges, procedures, and acceptance or rejection of galvanized steel material shall conform with ASTM A 123 or A 153 as applicable. Inspections and tests shall include the following:

1. Visual examination of samples and finished products.

2. Tests to determine weight or mass of zinc coating per square foot of metal surface.

C. Certification

1. A Certificate of Compliance shall be provided with each lot stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.

2. Submit with the Certification for each lot, actual weight data and dry coating thickness for test specimens.

PART 3 EXECUTION

3.1 PREPARATION

A. Delivery, Storage, and Protection

1. Items without Passivation.

a. Store in a dry area protected from the weather.

b. Store in a manner that promotes good air circulation between items.

c. Do not store outside under tarps.

d. Comply with AHDGA Publication MA-10.

2. Items with Passivation. Item shall be loaded and stored as follows to prevent the formation of wet storage stain:

a. The articles shall be stacked or bundled to allow air between the galvanized surfaces during transport from the supplier. Additionally, the material shall be loaded in such a manner that continuous drainage will occur.

b. Comply with AHDGA Publication MA-10.

c. In storage, the articles shall be raised from the ground and separated with strip spaces to provide free access of air to most

parts of the surface. They shall also be inclined in a manner which will allow continuous drainage. Under no circumstances shall galvanized steel be allowed to rest on cinders or clinkers; neither shall it be stored on wet soil or vegetation.

3.2 INSTALLATION

A. Mechanical Damage

1. Engineer/Architect will review damage caused by such acts as drilling, welding, flame cutting, handling, transport, or erection. Engineer/Architect will determine if damaged areas are field repairable or if re-galvanizing by the hot dip process is required. Field repairable damage shall be repaired in accordance with Section 09 90 00 of these specifications. All repair of damaged surfaces is to be accomplished at no additional cost to the Owner.

2. Touch up prime painted surfaces with the same primer applied in the shop. Clean damaged surfaces to ensure proper paint adhesion.

3. Comply with Section 09 90 00 for all painting.

4. All mil thicknesses may be verified by use of a magnetic thickness gauge.

B. **Wet Storage Stain Damage**. Any wet storage stain shall be removed by the galvanizer if formed and discovered prior to leaving the galvanizer's plant, unless late pickup or acceptance of delivery has necessitated the material being stored in unfavorable conditions. In any event, wet storage stain shall be removed before installation so that premature failure of the coating will not occur. Wet storage stain shall be removed as follows:

1. The objects shall be arranged so that their surfaces dry rapidly.

2. Light deposits are to be removed by means of a stiff bristle (not wire) brush. Heavier deposits are to be removed by brushing with a 5 percent solution of sodium or potassium dichromate with the addition of 0.1 percent by volume of concentrated sulfuric acid. This is to be applied with a stiff bristle brush and left for about 30 seconds before thoroughly rinsing and drying. Alternatively a proprietary product such as Oakite Highlite or equal which is intended for this purpose may be used according to manufacturer's recommendations.

3. A coating thickness check will be made by the Contractor in the affected areas to ensure that the zinc coating remaining after the removal of wet storage stain is sufficient to meet or exceed the requirements of this specification.

3.3 FIELD QUALITY CONTROL

A. Field Inspection and Tests

1. Galvanized items may be field checked by and at the discretion of the Owner or the Engineer with a magnetic thickness gauge to determine adequacy of the zinc coating thickness.

2. The following conversion ratio shall be used:

a. 1.0 ounce per square feet (oz/sf) = 1.7 mils.

3. Inspection shall be in accordance with MA-2 of the AHDGA.

4. All components designated for galvanizing shall receive a minimum galvanize coating of 2.0 oz/sf or 3.4 mils, if not specifically listed in the ASTM guidelines. Items with coating thicknesses not meeting those specified herein will be rejected and shall be returned to the galvanizing subcontractor for compliance with the specifications.

END OF SECTION

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SECTION 05 05 23

ANCHOR BOLTS, EXPANSION ANCHORS, AND ADHESIVE ANCHORS AND DOWELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, tools, and equipment necessary to furnish and install the anchor rods, expansion anchors, and adhesive anchors and dowels in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Standards**. Ensure that materials and workmanship are in conformance with the following standards as referenced herein:

1. AISI – American Iron and Steel Institute.
2. ASTM – American Society for Testing and Materials.

B. **Installer Training**. Conduct a thorough training with the manufacturer or the manufacturer's representative. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:

1. Hole drilling procedure.
2. Hole preparation and cleaning technique.
3. Adhesive injection technique and dispenser training/maintenance.
4. Rebar dowel preparation and installation.
5. Proof loading/torquing.

1.4 SUBMITTALS

A. Submit the following submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Shop Drawings, Product Data, and Design Criteria

1. Schedule. No products shall be delivered or installed before this submittal package has been reviewed and approved.
2. Submittal Package Contents.
    a. Copies of manufacturer's specifications, load tables, data, and dimension diagrams for the devices including manufacturer's recommended working load for each size and type of anchor proposed for use.
    b. Certification that materials conform to ASTM specifications.
    c. Certification that products conform to requirements of Underwriters' Laboratory or Factory Mutual.

d. Setting drawings and templates for location and installation of anchorage devices.

e. Anchor rods and bolts showing dimensions and material of construction.

f. When the size, length, or load carrying capacity of an anchor rod, expansion anchor, and adhesive anchor is not shown on the drawings, provide the size, length, and capacity required to carry the design load times a minimum safety factor of four.

g. Design Loads. Those imposed by the service conditions and as follows:

1) Equipment Anchors. Use the design load recommended by the equipment manufacturer and accepted by the Owner or Engineer.
2) Allowances for vibration are included in the safety factor specified above.

h. Design Data. Provide design load documentation and calculations for items sized or selected.

i. Installation instructions for adhesive anchors.

C. Submittal Package No. 2 – Samples

1. Schedule. No equipment shall be delivered or installed before this submittal package has been reviewed and approved.

2. Submittal Package Contents. Two samples of each type anchor and its components. Samples of anchor rods will not be required.

1.5 JOB CONDITIONS (Not used)

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Clearly mark all items according to purpose and intended location.

B. **Storage and Handling**. Store and handle all items in accordance with the manufacturer's recommendations, but in no case exposed to the weather.

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 MATERIALS/MANUFACTURERS

A. Threaded and Nutted Anchor Rods

1. In accordance with ASTM A 276, AISI Type 316.

2. Nuts in accordance with ASTM F 594, Group 2, and tack-welded to anchor rod.

B. Cracked Concrete Anchors

1. Provide cracked concrete anchors where International Building Code (IBC) 2018 is the design code and specified on the drawing details. Anchors that are approved for "cracked concrete" situations shall meet the requirements stated in ACI-318-19 Chapter 17.

2. Manufacturers. Subject to compliance with the specifications, provide cracked concrete anchors from one of the following approved manufacturers.

a. Expansion Anchors

1) Simpson Strong-Tie, Strong-Bolt 2.
2) Hilti, Inc., Kwik-Bolt-TZ.
3) Simpson Titan-HD.
4) Hilti HSL-3.
5) Hilti HDA.

b. Adhesive Anchors

1) Simpson Strong-Tie SET-XP
2) Hilti HIT-RE 500 V3.

C. Expansion Anchors

1. Provide stainless steel expansion anchors, nuts, and washers complying with ASTM A 276, AISI Type 316.

2. Expansion anchors shall be Underwriters' Laboratories, Factory Mutual, or International Code Council – Evaluation Service (ICC-ES) report approved.

3. Subject to compliance with the specifications, provide expansion anchors from one of the following approved manufacturers.

a. Simpson Strong-Tie, Wedge-All.

b. Wej-it Corporation.

c. Hilti, Inc., Kwik-Bolt 3.

d. Ramset Company, Red Head, Trubolt.

D. Adhesive Anchors

1. Provide adhesive cartridge as recommended by the manufacturer for the loading and depth required.

2. Provide Type 316 stainless steel threaded rod, nut, and washer or a reinforcing bar of the size and embedment shown on the drawings and in accordance with ASTM A 615, Grade 60.

3. Subject to compliance with the specifications, provide adhesive cartridges from one of the following approved manufacturers.

a. Simpson Strong-Tie, SET Epoxy.

b. Simpson Strong-Tie, AT Acrylic Adhesive.

c. Hilti, HIT-HY 200.

d. ITW/Red Head, C6+ Epoxy.

e. Hilti HIT-RE 500 V3.

E. Adhesive-Anchored Reinforcing Bar.

1. Provide adhesive cartridges as recommended by the manufacturer to receive reinforcing bar as noted.

2. Manufacturer/Model. Subject to compliance with the specifications, provide adhesive cartridges from one of the following approved manufacturers.

a. Simpson Strong-Tie, SET Epoxy.

b. Simpson Strong-Tie, AT Acrylic Adhesive.

c. Hilti HIT-RE 500 V3.

d. ITW/Red Head, C6+ Epoxy.

e. Hilti HIT-HY 200.

3. Reinforcing Bar. Comply with Section 03 30 00.

F. **Powder-Actuated Fasteners**. Do not use powder-actuated fasteners and other types of bolts and fasteners.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions under which rods, bolts and anchors are to be installed, and notify the Engineer in writing of unsatisfactory conditions existing. Do not proceed with the work until unsatisfactory conditions or deficiencies have been corrected.

3.2 PREPARATION

A. Notify the Engineer prior to the installation of all adhesive anchors.

3.3 INSTALLATION

A. **Do not install** anchor rods, expansion anchors, or adhesive anchors until the item to be anchored and the anchoring device as well as related layout drawings have been accepted.

B. **Drilling and setting equipment** used and installation of expansion anchors and adhesive anchors shall be in accordance with manufacturer's instructions.

C. **Drill holes to depth** and diameter recommended by manufacturer.

D. **Clean all holes** for adhesive anchors in strict accordance with the manufacturer's instructions.

E. Use the type of anchoring device shown.

F. **Unless otherwise shown**, conform to following for expansion anchors.

1. Minimum embedment depth in concrete – 5 diameters.

2. Minimum anchor spacing on centers – 10 diameters.

3. Minimum distance to edge of concrete – 5 diameters.

4. Increase dimensions above if required to develop the required anchor load capacity.

G. **Unless otherwise shown**, conform with the manufacturer's recommendations for minimum embedment depth, minimum anchor spacing, and minimum edge distance for adhesive anchors except that minimum embedment depth in concrete shall not be less than 4 inches unless noted otherwise.

H. **Use copper-graphite antiseize** compound for all anchor nuts. Thoroughly lubricate all threaded fasteners with compound prior to assembly. Remove excess lubricant after fastener installation.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Inspect each installation for compliance with this specification and manufacturer's recommendations.

B. **Testing**. At the discretion of the Owner, adhesive anchors may be subjected to pullout-type testing up to the manufacturer's recommended working load for the anchor. If deficient anchors are found, the Contractor will be required to test all anchors and replace any deficient anchors found at no additional cost to the Owner.

C. Material Testing

1. At the discretion of the Owner up to 1 percent or up to three (whichever is greater) of each type and size of bolt, nut, washer, and anchor from each and every separate shipment or purchasing lot that are specified to be Type 316 stainless steel may be destructively tested to verify material requirements.

2. Samples will be randomly selected for this testing and be provided at no additional cost to the Owner.

3. Conduct testing at the Owner's expense.

4. The above testing may be performed at any time during the Contract.

5. Any shipment or purchasing lot, installed or not, which fails to meet the requirements of the specifications will be rejected and shall be immediately removed from the job site and replaced with material that meets the specifications.

6. Removal and replacement of noncomplying material shall be at the Contractor's expense.

3.5 CLEANING

A. After embedding concrete is placed, remove protection and clean rods, anchors, and inserts.

END OF SECTION

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SECTION 05 10 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the structural steel in accordance with the plans and as specified herein.

B. **Types.** This section includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.

1. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.

2. Miscellaneous metal fabrications are specified elsewhere in Division 5.

3. Refer to Division 3 for anchor bolt installation in concrete and Division 4 for anchor bolt installation in masonry.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies.** Perform all work to furnish and install the structural steel in compliance with all federal, state, and local codes and regulatory agencies. Comply with provisions of following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges."

a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence:

1) "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings."

2. AISC "Specifications for Structural Steel Buildings," including "Commentary."

3. "Specifications for Structural Joints Using American Society for Testing and Materials (ASTM) A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.

4. ASTM A 6 "General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

B. **Qualifications for Fabricator.** Fabricator shall have a current "AISC Quality Certification Category II."

C. **Qualifications for Welding Work.** Qualify welding procedures and welding operators in accordance with American Welding Society (AWS) "Qualification" requirements.

1. If recertification of welders is required, retesting will be Contractor's responsibility.

1.4 SUBMITTALS

A. **General.** Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

B. **Product Data**. Product data or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel primer paint.

2. Shrinkage resistant grout.

C. **Shop drawings prepared under supervision** of a licensed Professional Engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.

2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

D. **Test reports conducted on field-bolted** and welded connections. Include data on type(s) of tests conducted and test results.

E. **Certified copies of each survey** conducted by a licensed Land Surveyor, showing elevations and locations of base plates and anchor bolts to receive structural steel and final elevations and locations for major members. Indicate discrepancies between actual installation and Contract Documents.

F. **Provide certification** that welders to be employed in work have satisfactorily passed AWS qualification tests.

1.5 JOB CONDITIONS

A. **General.** Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. **Deliver anchor bolts** and anchorage devices which are to be embedded in cast-in-place concrete or masonry in ample time as not to delay work.

C. **Store materials to permit easy access** for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.

1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel Wide Flange Shapes. ASTM A 992.

B. All Other Structural Steel Shapes, Plates, and Bars. ASTM A 36 unless noted otherwise.

C. Cold-Formed Steel Tubing. ASTM A 500, Grade B.

D. **Steel Pipe.** ASTM A 53, Type E or S, Grade B; or ASTM A 501.

1. Finish. Black, except where indicated to be galvanized.

E. **Steel Castings.** ASTM A 27, Grade 65-35, medium strength carbon steel.

F. **Anchor Bolts and Threaded Rods.** ASTM F 1554, Grade 36 headed type unless otherwise indicated.

G. **Unfinished Threaded Fasteners.** ASTM A 307, Grade A, regular low carbon steel bolts and nuts.

1. Provide hexagonal heads and nuts for all connections.

H. **High-Strength (and Alternate Fastener Design) Threaded Fasteners.** Heavy hexagonal structural bolts, heavy hexagonal nuts, and hardened washers, as follows:

1. Quenched and tempered medium carbon steel bolts, nuts, and washers, complying with ASTM A 325.

a. Where indicated as galvanized, provide units that are zinc coated, either mechanically deposited complying with ASTM B 695, Class 50, or hot dip galvanized complying with ASTM A 153.

I. **Direct Tension Indicators.** ASTM F 959, type as required.

1. Use on all A 325 bolts in connections that are slip critical.

J. Electrodes for Welding. Comply with AWS Code.

K. **Structural Steel Primer Paint.** Where noted, Steel Structures Painting Council (SSPC) - Paint 2 oil alkyd unless specified otherwise in Section 09 90 00, "Painting."

L. **Galvanizing**. Structural shapes shall be hot dip galvanizing after fabrication unless otherwise noted and it shall be done in accordance with ASTM A 123. See Section 05 05 14.

M. **Nonmetallic, Shrinkage Resistant Grout.** Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing, and water reducing agents, complying with ASTM C 1007.

1. Available Products. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Sure Grip Grout; Dayton Superior.

b. Euco N.S.; Euclid Chemical Co.

c. Crystex; L & M Construction Chemicals, Inc.

d. Masterflow 713; Master Builders.

e. Sealtight 588 Grout; W. R. Meadows.

f. Five Star Grout; U.S. Grout Corp.

2.2 FABRICATION

A. **Shop-Fabrication and Assembly.** Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. **Remove all surface blemishes** including rust and scale seam marks, roller marks, rolled trade names, and roughness by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes to steel which is exposed to view.

C. **Anchor Bolts.** Provide anchor bolts where indicated on the drawings.

D. **Connections.** Weld or bolt shop connections, as indicated.

1. Provide high strength threaded fasteners for all bolted connections, except where unfinished bolts are indicated.

2. Design connections to develop 55 percent of the load capacity of the member as tabulated in the beam tables, Part 2, of the AISC "Manual of Steel Construction" unless reactions or specific details are shown.

3. Connections for bracing shall be designed to develop full strength of bracing members unless forces are shown.

E. **Bolt field connections,** except where welded connections or other connections are indicated.

F. **High-Strength Bolted Construction.** Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts."

G. **Welded Construction.** Comply with AWS code and appearance requirements specified herein.

H. **Steel Wall Framing.** Select members that are true and straight for fabrication of steel wall framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

I. **Build up welded door frames** attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug weld steel bar stops to frames, except where shown removable. Secure removable stops to frames with countersunk, cross recessed head machine screws, uniformly spaced not more than 10 inches on center (o.c.), unless otherwise indicated.

J. **Holes for Other Work.** Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members.

K. **Provide threaded nuts** welded to framing and other specialty items as indicated to receive other work.

L. **Cut, drill, or punch holes** perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING

A. **General.** Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

1. Do not paint surfaces to be welded or high strength bolted with friction type connections.

2. Do not paint surfaces scheduled to receive sprayed-on fireproofing.

3. Apply two coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

B. **Surface Preparation.** After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with SSPC as follows:

1. SP-6 "Commercial Blast Cleaning," unless specified otherwise in Section 09 90 00, "Painting."

C. **Painting.** If not specified otherwise in Section 09 90 00, "Painting," immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.4 SOURCE QUALITY CONTROL

A. **General.** Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1. Promptly remove and replace materials or fabricated components that do not comply.

B. **Design of Members and Connections.** Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

1. Promptly notify Engineer/Architect whenever design of members and connections for any portion of structure are not clearly indicated.

2. For connections not detailed on the plans and unless specific reactions, moments, shears, and axial forces are indicated, provide beam connections designed for the reaction due to the maximum uniform load which the beam can support at the span shown. Use the beam tables in the AISC "Manual of Steel Construction, Allowable Stress Design."

PART 3 EXECUTION

3.1 EXAMINATION

A. **Surveys.** Employ a licensed Land Surveyor for accurate erection of structural steel. Report discrepancies to Engineer/Architect. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steelwork have been agreed upon with Engineer/Architect.

1. Check elevations of concrete and masonry bearing surfaces and location of anchor bolts and similar devices.

2. Check camber and sweep of structural members and compare to permissible variations in AISC "Manual of Steel Construction."

3. Check levelness and elevations of leveling plates and bearing plates.

B. **Examine all structural steel** and discard all damaged members.

3.2 PREPARATION

A. **Anchor Bolts.** Provide anchors as to not delay work.

1. Provide setting drawings to ensure accurate placement.

B. **Temporary Shoring and Bracing.** Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds and to resist wind and earthquake loads.

C. **Temporary Planking.** Provide temporary planking and working platforms as necessary to effectively complete work.

D. **Setting Bases and Bearing Plates.** Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

4. For proprietary grout materials, comply with manufacturer's instructions.

3.3 ERECTION

A. **General.** Comply with Occupational Safety and Health Administration (OSHA) and state safety requirements.

B. **Field-Assembly.** Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

C. **Straightening of structural steel sections** by heating shall not be permitted unless approved by Engineer/Architect.

D. **Level and plumb individual members** of structure within specified AISC tolerances.

E. **Splice members** only where indicated and accepted on shop drawings.

F. **Erection Bolts.** On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Do not enlarge unfair holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

G. **Gas Cutting.** Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Engineer/Architect. Finish gas cut sections equal to a sheared appearance when permitted.

H. **Touch-Up Painting.** Unless otherwise specified in Section 09 90 00, "Painting," immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.4 QUALITY CONTROL

A. **General.** Contractor will engage an independent testing and inspection agency to inspect, perform test, and prepare test reports on high strength bolted connections and welded connections. Welds will be visually inspected and some or all welds will be nondestructively tested.

B. **Testing agency shall conduct** and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations from them.

C. **Provide fabrication schedule** for testing agency so that required inspection and testing can be accomplished.

D. **Provide access for testing agency** to places where structural steelwork is being fabricated or produced and to the construction site so that required inspection and testing can be accomplished.

E. Testing agency may inspect structural steel at plant before shipment.

F. Testing agency will inspect structural steel at the site.

1. Field-Bolted Connections. Inspect in accordance with Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using A325 or A490 Bolts."

a. For direct tension indicators, comply with requirements of ASTM F 959. Verify that gaps are less than gaps specified in Table 2.

2. Field-Welding. Inspect and test during erection of structural steel in accordance with Section 6 of AWS D1.1.

a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.

b. Perform visual inspection of all welds.

c. Perform tests on 100 percent of the full and partial penetration welds as follows. Inspection procedures listed are to be used at Contractor's option.

1) Liquid Penetrant Inspection. ASTM E 165.

2) Magnetic Particle Inspection. ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.

3) Radiographic Inspection. ASTM E 94 and ASTM E 142; minimum quality level "2-2T."

4) Ultrasonic Inspection. ASTM E 164.

3. Steel Framing. Inspect and verify compliance with the details shown on the approved Contract Documents.

G. **Correct deficiencies in structural steel work** that independent inspections and laboratory test reports have indicated to be not in compliance with Contract Documents. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

END OF SECTION

SECTION 05 31 00

STEEL DECK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Furnish and install the galvanized steel decking as shown on the plans and as specified herein.

B. **Types**. This section includes steel deck units for roof applications.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Comply with provisions of the following codes and standards, except as otherwise indicated:

1. American Iron and Steel Institute (AISI) "Specification for the Design of Cold Formed Steel Structural Members."

2. American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."

3. Steel Deck Institute (SDI) "Design Manual for Composite Decks, Form Decks and Roof Decks."

4. SDI "Specification for Steel Roof Deck."

B. **Qualification of Field Welding**. Use qualified welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS.

C. **Factory Mutual (FM) Listing**. Provide steel roof deck units that have been evaluated by FM System and are listed in "Factory Mutual Approval Guide" for "Class I" fire-rated construction.

1.4 SUBMITTALS

A. **General**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data including manufacturer's specifications and installation instructions for each type of decking and accessories.

a. Provide test data for mechanical fasteners used in lieu of welding for fastening deck to supporting structures.

2. Shop drawings showing layout and types of deck units, anchorage details, and conditions requiring closure strips, supplementary framing, sump pans, cant strips, cut openings, special jointing, and other accessories.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:

1. Epic Metals Corp.
2. H. H. Robertson Co.
3. United Steel Deck, Inc.
4. Vulcraft Div., Nucor Corp.
5. Wheeling Corrugating Co.

2.2 MATERIALS

A. **Steel for Galvanized Metal Deck Units**. American Society for Testing and Materials (ASTM) A 653 Grade A with coating designation G60 (galvanizing), except G90 where exposed to weather or humid environments or noted on drawings.

B. Miscellaneous Steel Shapes. ASTM A 36.

C. **Sheet Metal Accessories**. ASTM A 653 Grade A with coating designation G60 (galvanizing) except G90 where exposed to weather or humid environment or noted on drawings.

D. **Flexible Closure Strips**. Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

E. **Acoustic Sound Barrier Closures**. Manufacturer's standard mineral fiber closures.

2.3 FABRICATION

A. **General**. Form deck units in lengths to span three or more supports, with flush, telescoped, or nested 2-inch laps at ends and interlocking or nested side laps, of metal thickness, depth, and width as indicated.

B. **Roof Deck Units**. Provide deck configurations that comply with SDI "Specifications and Commentary for Steel Roof Deck."

C. **Metal Closure Strips**. Fabricate metal closure strips for openings between decking and other construction. Form to provide tight-fitting closures at open ends of cells or flutes and sides of decking.

D. **Roof Sump Pans**. Fabricate from single piece of 0.071-inch-minimum (14-gauge) galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3 inches wide. Recess pans not less than 1-1/2 inches below roof deck surface unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field by others.

E. **Miscellaneous Items.** Provide miscellaneous items such as cant strips, ridge and valley plates, filler sheets, pour stops, etc., as needed to provide a completed product.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Examine steel deck** and discard all damaged units.

3.2 PREPARATION

A. **Prior to deck installation**, verify that all structural members and supports are in place and ready for deck installation.

B. **Prior to deck installation**, verify that concrete supporting structure has cured and is dry.

3.3 INSTALLATION

A. **General**. Install deck units and accessories in accordance with manufacturer's recommendations and shop drawings, and as specified herein.

B. **Place deck units** on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.

C. **Align deck units** for entire length of run of cells and with close alignment between cells at ends of abutting units.

D. **Place deck units** flat and square, secured to adjacent framing without warp or deflection.

E. **Coordinate and cooperate** with structural steel erector in locating decking bundles to prevent overloading of structural members.

F. Fastening Deck Units

1. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

    a. Use welding washers where recommended by deck manufacturer.

2. Mechanical fasteners, either powder actuated or pneumatically driven, may be used in lieu of welding. Locate mechanical fasteners and install in accordance with deck manufacturer's instructions.

3. Attach metal roof deck as follows unless indicated otherwise:

Location	Weld or Screw Size	Weld Spacing
Supporting Members	5/8-inch-diameter puddle weld	12 inches on center
Side Laps (20 Gauge or Thicker)	5/8-inch-diameter weld or 3/8 x 1-1/4" seam weld or No. 10 screw	One per span not to exceed 36 inches on center
Side Laps (22 Gauge or Thinner)	No. 10 screw	One per span not to exceed 36 inches on center

4. Uplift Loading. Install and anchor roof deck units to resist gross uplift loading of 45 pounds per square foot (psf) at eave overhang and 30 psf for other roof areas.

G. **Cutting and Fitting**. Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown.

H. **Reinforcement at Openings**. Provide additional metal reinforcement, column closures, and closure pieces as required for strength, continuity of decking, and support of other work shown.

I. **Hanger Tabs**. Provide UL-approved hanger tabs where deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.

1. For metal roof deck provide nonpiercing or integral hanger tabs with an allowable load of 100 pounds per tab with a safety factor of 5.

2. Locate slots or clips at not more than 14 inches on center in both directions, not over 9 inches from walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.

3. Provide manufacturer's standard hanger attachment devices.

J. **Joint Covers**. Provide metal joint covers at abutting ends and changes in direction of floor deck units, except where taped joints are required.

K. **Roof Sump Pans**. Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches on center with at least one weld at each corner.

L. **Closure Strips**. Provide metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.

1. Provide flexible closure strips instead of metal closures, at Contractor's option, wherever their use will ensure complete closure. Install with adhesive in accordance with manufacturer's instructions.

M. **Touch-Up Painting**. After decking installation, wire brush, clean, and paint scarred areas, welds, and rust spots on top and bottom surfaces of decking units and supporting steel members.

1. Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.
2. Touch up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.
3. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.

N. **In areas where shop-painted surfaces** are to be exposed, apply touch-up paint to blend into adjacent surfaces.

END OF SECTION

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SECTION 05 51 10

FIXED METAL LADDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fixed aluminum wall ladders.

1.2 RELATED SECTIONS

A. **Section 05 00 00** – Grating and Miscellaneous Metals.

1.3 REFERENCES

A. **ANSI A14.3** - American National Standard for Ladders -- Fixed -- Safety Requirements; 1992.

B. **ASTM B 209** - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2001.

C. **ASTM B 209M** - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2001.

D. **ASTM B 210** - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2002.

E. **ASTM B 221** - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2000.

F. **ASTM B 221M** - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2000.

G. **ASTM B 308** - Standard Specification for Aluminum - Alloy T6061-T6 Standard Structural; 2002.

H. **ASTM B 308M** - Standard Specification for Aluminum - Alloy T6061-T6 Standard Structural; 2002.

I. **OSHA 29 CFR** Standard 1910.27 - Fixed ladders; Occupational Safety and Health Standards; current edition.

1.4 SUBMITTALS

A. **Submit** under provisions of Section 01 33 00.

B. **Product Data:** Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

C. **Shop Drawings**: Detailed drawings showing complete dimensions, all materials, mounting attachments, and fabrication details.

1.5 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: Company specializing in the engineering and manufacturing of metal ladders, with not less than fifty years of experience.

1.6 WARRANTY

A. **Provide manufacturer's** standard limited five-year warranty against defects in materials and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: ALACO Ladder Co.

B. Or approved equal.

2.2 MATERIALS

A. **Extruded Aluminum Profiles:** ASTM B 221/B 221M, ASTM B 210, ASTM B 308/B 308M, Alloy 6061-T6; standard mill finish.

B. **Aluminum Sheet and Plate:** ASTM B 209/B 209M, Alloy 6061-T6; standard mill finish.

C. **Fasteners**: Aluminum solid aircraft rivets rated at 300 lbs (1335 N) shear strength.

D. **Cast fittings**, connectors and rung ends: Cast Aluminum alloy 356.

2.3 LADDERS

A. **Ladders** - General: Comply with ANSI A14.3 and OSHA regulations.

B. **Fixed Wall Ladders**: Extruded aluminum; serrated rungs 1-1/8 inches (29 mm) in diameter, connected to 2-7/8 inch (73 mm) side rail channels with cast aluminum rung connectors, each secured to rails by means of four solid aircraft rivets.

1. Walk-Through and Parapet Railings: Aluminum extrusions; extend not less than 42 inches (1,067 mm) above landing, 24 in (610 mm) between side rails at step through.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. **Install in accordance** with manufacturer's instructions and approved shop drawings, and in compliance with ANSI A14.3 and OSHA 1910.27.

3.3 PROTECTION

Protect installed products until completion of project.

A. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 05 52 13

PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to furnish and install the pipe and tube railings in accordance with the plans and specifications.

B. This section includes the following:

1. Aluminum pipe and tube handrails and railing systems.

2. Steel pipe portable roof safety railing systems.

3. Steel pipe wall mounted roof safety railing systems.

1.3 QUALITY ASSURANCE

A. **Single-Source Responsibility**. Obtain handrails and railing systems of each type and material from a single manufacturer.

B. **Engineering Responsibility**. Engineer handrails and railing systems by professional engineer legally authorized to practice in jurisdiction where project is located.

1.4 SUBMITTALS

A. Submit the following in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Product Data and Shop Drawings

1. Product data for each type of product specified.

2. Shop drawings showing fabrication and installation of handrails and railings including plans, elevations, sections, details of components, and attachments to other units of work.

a. Where installed products are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by a qualified professional engineer responsible for their preparation.

3. Product test reports from and based on tests performed by qualified independent testing laboratory evidencing compliance of railing components and systems with requirements based on comprehensive testing of current products.

4. Test reports from independent testing laboratory evidencing compliance of handrails and railing systems with ASTM E 985.

5. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineer/Architects and Owners, plus other information specified.

C. Submittal Package No. 2 – Samples

1. Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors available for those units with factory applied color finishes.

2. Samples for verification purposes of each type of exposed finish required, prepared on components indicated below that are of the same thickness and metal indicated for final unit of work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

a. 6-inch-long sections of each distinctly different linear railing member including handrails, top rails, posts, and balusters.

b. Fittings and brackets.

c. Welded connections.

1.5 JOB CONDITIONS

A. Field Measurements

1. Where handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings.

2. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabrication of products without field measurements.

3. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 60 00.

1.7 SPECIAL WARRANTY (Not Used)

1.8 DEFINITIONS

A. Definitions in American Society for Testing and Materials (ASTM) E 985 for railing related terms apply to this section.

1.9 SYSTEM PERFORMANCE REQUIREMENTS

A. **General**. In engineering handrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. For Stainless Steel. American Iron and Steel Institute (AISI) "Stainless Steel Cold-Formed Structural Design Manual."

2. For Aluminum. Aluminum Association (AA) "Specifications for Aluminum Structures."

B. **Delegated Design: Structural Performance of Handrails and Railing Systems**. Design, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

1. Top Rail of Guardrail Systems. Capable of withstanding the following loads applied as indicated:
    a. Concentrated load of 200 pounds applied at any point and in any direction.
    b. Uniform load of 50 pounds per foot applied horizontally at the required guardrail height and a simultaneous uniform load of 100 pounds per foot applied vertically downward at the top of the guardrail.
    c. Concentrated load need not be assumed to act concurrently with uniform loads.
2. Handrails Not Serving as Top Rails. Capable of withstanding the following loads applied as indicated:
    a. Concentrated load of 200 pounds applied at any point and in any direction.
    b. Uniform load of 50 pounds per foot applied in any direction.
    c. Concentrated and uniform loads need not be assumed to act concurrently.
3. Infill Area of Guardrail Systems. Capable of withstanding a horizontal concentrated load of 200 pounds applied to 1 square foot (sf) at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area. Concentrated load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

C. **Control of Corrosion**. Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. **Thermal Movements**. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature of 120 degrees Fahrenheit (° F.) in the design, fabrication, and installation of handrails and railings to prevent buckling, opening up of joints, overstressing of components, connections and other detrimental effects. Base design calculation on actual material surface temperature range of 180° F. due to both solar heat gain and nighttime sky heat loss.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering handrails and railing systems that may be incorporated in the work include but are not limited to the following:

B. Aluminum Pipe and Tube Railing Systems

1. Blum. Julius Blum & Co., Inc.
2. Moultrie Manufacturing Co.
3. Superior Aluminum Products, Inc.
4. Wagner. R & B Wagner, Inc.

C. Steel Portable and Wall Mounted Roof Safety Railing Systems

1. Safety Rail Company LLC – Basis of Design.
2. Blue Water Manufacturing, Para Rail Guardrail System
3. Kee Safety, Inc., KeeGuard
4. Flexible Lifeline Systems, FlexGuard

2.2 METALS

A. **General**. Provide metal forms and types that comply with requirements of referenced standards and that are free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.

B. **Aluminum**. Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, with not less than the strength and durability properties of the alloy and temper designated below for each aluminum form required:

1. Extruded Bar and Tube. ASTM B 221, alloy 6063T5/T52.
2. Extruded Structural Pipe and Tube. ASTM B 429, 6063-T5/T52.
3. Drawn Seamless Tube. ASTM B 210, 6063-T832.
4. Plate and Sheet. ASTM B 209, 6061-T6.
5. Die and Hand Forgings. ASTM B 247, 6061-T6.
6. Castings. ASTM B 26, A356-T6.

C. **Steel.** Galvanized steel coating recommended by railing manufacturer.

D. **Brackets, Flanges, and Anchors**. Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

2.3 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. **Welding Electrodes and Filler Metal**. Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. **Fasteners for Anchoring Railings to Other Construction**. Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railing to other types of construction indicated and capable of withstanding design loadings.

1. For aluminum railings, provide fasteners fabricated from Type 304 stainless steel.

C. Fasteners for Interconnecting Railing Components

1. Use fasteners of same basic metal as the fastened metal, unless otherwise indicated.

2. Do not use metals that are corrosive or incompatible with materials joined.

3. Provide concealed fasteners for interconnection of handrail and railing components and for their attachment to other work, except where otherwise indicated.

4. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. **Cast-in-Place and Post-Installed Anchors in Concrete**. Anchors of type indicated below, fabricated from corrosion resistant materials with capability to sustain, without failure, load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.

1. Cast-in-place anchors.

2. Chemical anchors.

2.4 FABRICATION

A. **General**. Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than those required to support structural loads.

B. Railing Systems

1. Preassemble railing systems in shop to greatest extent possible to minimize field splicing and assembly.

2. Disassemble units only as necessary for shipping and handling limitations.

3. Clearly mark units for reassembly and coordinated installation.

4. Use connections that maintain structural value of joined pieces.

5. Clearly mark units for reassembly and coordinated installation.

C. **Form changes in direction** of railing members as follows:

1. By insertion of prefabricated elbow fittings.

2. By radius bends of radius indicated.

3. By mitering at elbow bends.

4. By bending.

5. By any method indicated above, applicable to change of direction involved.

D. **Form simple and compound curves** by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. **Welded Connections**. Fabricate railing systems and handrails for connection of members by welding. For connections made during fabrication, weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.

5. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

6. Use welded connections only where non welded connections are not feasible for structural or other approved reasons.

F. Nonwelded Connections

1. Fabricate railing systems and handrails for connection of members by means of railing manufacturer's standard concealed mechanical fasteners and fittings unless otherwise indicated.

2. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

3. Fabricate splice joints for field connection using epoxy structural adhesive where this represents manufacturer's standard splicing method.

G. **Welded Connections for Aluminum Pipe**. Fabricate pipe handrails and railing systems for connection of members by concealed internal welds, which eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

H. **Brackets, Flanges, Fittings, and Anchors**. Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors for interconnection of handrail and railing members to other construction.

I. **Provide inserts and other anchorage devices** for connecting handrails and railing systems to concrete or masonry work.

1. Fabricate anchorage devices capable of withstanding loadings imposed by handrails and railing systems.

2. Coordinate anchorage devices with supporting structure.

J. **For removable railing posts**, fabricate slip fit sockets from steel pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12 of post height.

1. Provide socket covers designed and fabricated to resist accidental dislodgement.

2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated.

3. Fabricate from same metal as railings.

K. **Shear and punch metals** cleanly and accurately**.** Remove burrs from exposed cut edges.

L. **Ease exposed edges to a radius** of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

M. **Cut, reinforce, drill, and tap miscellaneous metal work** as indicated to receive finish hardware, screws, and similar items.

N. **For handrails and railing systems** that are exposed to exterior or to moisture from condensation or other sources, provide weepholes or other means for evacuation of entrapped water in hollow sections of railing members.

O. **Fabricate joints that will be exposed** to weather in a manner to exclude water.

P. **Provide wall returns at ends** of wall-mounted handrails, unless otherwise indicated.

Q. **Toe Boards**. Where indicated, provide toe boards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated for connection to, and centered between, each railing post.

R. **Fillers**. Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

S. Roof Safety Rail System.

1. Provide bases with pads to protect roof surface from damage for portable railings.

2. Provide manufacturer’s standard brackets, and other attachment components as needed to secure railings to wall construction indicated.

2.5 FINISHES, GENERAL

A. **Comply with National Association of Architectural Metals Manufacturers** (NAAMM) "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. **Protect mechanical finishes** on exposed surfaces from damage by application of strippable, temporary protective covering prior to shipment.

C. Appearance of Finished Work

1. Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of the range of approved samples.

2. Noticeable variations in the same piece are not acceptable.

3. Variations in appearance of other components are acceptable if they are within range of approved samples and they are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. **Finish designations prefixed by "AA"** conform to the system established by the Aluminum Association for designating aluminum finishes.

B. **Class I Clear Anodized Finish**. AA-M12C22A41; Anodic Coating: Class I Architectural, clear film thicker than 0.7 mil) complying with AAMA 607.1.

C. **Roof Safety Rail System.** Provide manufacturer's standard clear finish.

PART 3 EXECUTION

3.1 **PREPARATION**. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Cutting, Fitting, and Placement

1. Perform cutting, drilling, and fitting required for installation of handrails and railings.

2. Set handrails and railings accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

3. Do not weld, cut, or abrade surfaces of handrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.

4. Set posts plumb within a tolerance of 1/4 inch in 12 feet.

5. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. **Field Welding**. Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

D. Install self-supporting freestanding railing systems to comply with railing manufacturer's instructions.

E. **Corrosion Protection**. Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint or zinc chromate primer.

F. **Fastening to In-Place Construction**. Provide anchorage devices and fasteners where necessary for securing handrails and railings to in-place construction.

3.3 ANCHORING POSTS

A. **Adjust handrails and railing systems prior** to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

B. **Cover anchorage joint** with a round steel flange welded to post after placement of anchoring material.

C. **Leave anchorage joint exposed**, wipe off surplus anchoring material, and leave 1/8-inch buildup, sloped away from post. For installations exposed on exterior or to flow of water, seal anchoring material to comply with grout manufacturer's directions.

D. **Anchor posts to metal surfaces** with oval flanges, angle type or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum pipe railings, attach posts as indicated using manufacturer's standard fittings designed and engineered for this purpose.

3.4 RAILING CONNECTIONS

A. Nonwelded Connections

1. Use manufacturer's standard mechanical or adhesive joints for permanently connecting railing components.

2. Use wood blocks and padding to prevent damage to railing members and fittings.

3. Seal recessed holes of exposed locking screws with plastic filler cement colored to match finish of handrails and railing systems.

4. Before installing freestanding railing system, prepare roof surface using methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. **Welded Connections**. Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact or use manufacturer's standard fittings designed for this purpose.

C. **Expansion Joints**. Install expansion joints at locations indicated but not further apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches of post.

3.5 ANCHORING RAIL ENDS

A. **Anchor rail ends into concrete** and masonry with round flanges connected to rail ends and anchored into wall construction with post installed anchors and bolts.

B. Anchor rail ends to metal surfaces with oval or round flanges.

1. Weld flanges to rail ends.

2. Connect flanges to rail ends using nonwelded connections.

3. Bolt flanges to metal surfaces.

C. **Install removable railing sections** where indicated in slip fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.

3.6 ATTACHMENT OF HANDRAILS TO WALLS

A. **Attach handrails to wall** with wall brackets and end fittings. Provide bracket with not less than 1 1/2 inch clearance from inside face of handrail and finished wall surface.

B. **Locate brackets as indicated** or, if not indicated, at spacing required to support structural loads.

C. **Secure wall brackets** and wall return fittings to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

2. Use type of bracket with predrilled hole for exposed bolt anchorage.

3. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.

4. For hollow masonry anchorage, use toggle bolts with square heads.

5. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with stud installations for accurate location of backing members.

6. For steel framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.

7. Use manufacturer's standard mounting brackets for wall mounted Roof Safety railings.

D. **Mount handrails** only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.

3.7 ADJUSTING AND CLEANING

A. **Touch-Up Painting**. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

B. **Clean** aluminum and stainless steel by washing thoroughly with clean water and soap, following by rinsing with clean water.

3.8 PROTECTION

A. **Protect finishes of railing systems** and handrails from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at time of Substantial Completion.

B. **Restore finishes damaged** during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION

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SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide all labor, materials, tools, and equipment necessary to construct rough carpentry in accordance with the plans and as specified herein.

B. **Work Included.** This section includes the following:

1. Wood grounds, nailers, blocking, and shims if needed at openings.

1.3 QUALITY ASSURANCE

A. **Codes.** Perform all work in compliance with all federal, state, and local codes.

B. **Standards.** Materials and workmanship shall be in accordance with the following standards:

1. AF&PA – American Forest & Paper Association.
2. AHA - American Hardwood Association.
3. AISI - American Iron and Steel Institute.
4. ALSC - American Lumber Standards Committee.
5. ANSI - American National Standards Institute.
6. APA - American Plywood Association.
7. ASTM - American Society for Testing and Materials.
8. AWPA - American Wood Preservers Association.
9. AWPB - American Wood Preservers Bureau.
10. Federal Specifications.
11. SPIB - Southern Pine Inspection Bureau.
12. UL - Underwriters' Laboratories, Inc.

C. **Regulatory Agencies.** Perform all work in compliance with the requirements of the following regulatory agencies:

1. ADA - Americans with Disabilities Act.
2. NFPA - National Fire Protection Association.
3. OSHA - Occupational Safety and Health Administration.

1.4 SUBMITTALS

A. **General.** Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

B. **Wood Treatment Data.** Submit wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing of treated material:

1. For each type of preservative-treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

2. For waterborne-treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.

C. **Warranties.** Submit copies of warranty of chemical treatment manufacturer for each type of treatment.

1.5 JOB CONDITIONS

A. **Coordination/Interfacing.** Coordinate with all other trades to prevent delays, errors, and omissions.

B. **Environmental Requirements.** Follow manufacturer's instructions for limitations of specified materials with regard to exposure to climatic conditions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery and Storage.** Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

1. For lumber and plywood pressure-treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.7 SPECIAL WARRANTY

A. **Chemical Treatment Warranty.** Manufacturer's written warranty for each type of chemical treatment required for the project.

1.8 DEFINITIONS

A. **Rough carpentry includes carpentry work** not specified as part of other sections and generally not exposed, unless otherwise specified.

PART 2 PRODUCTS

2.1 LUMBER, GENERAL

A. **Lumber Standards.** Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. **Inspection Agencies.** Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:

1. SPIB - Southern Pine Inspection Bureau.

C. **Grade Stamps.** Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

D. **Nominal Sizes.** Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

1. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.2 DIMENSION LUMBER

A. **Light Framing.** For light framing (2 to 4 inches thick, 2 to 4 inches wide), provide the following grade and species:

1. Standard grade.

2. Southern Pine graded under SPIB rules.

2.3 BOARDS

A. **Exposed Boards.** Where boards will be exposed in the finished work, provide the following:

1. Moisture Content. 19 percent maximum, S-DRY or KD-19.

B. **Concealed Boards.** Where boards will be concealed by other work, provide lumber of 19 percent maximum moisture content (S-DRY or KD-19) and of following species and grade:

1. Southern Pine No. 2 Boards per SPIB rules.

C. **Board Sizes.** Provide sizes indicated.

2.4 MISCELLANEOUS LUMBER

A. **General.** Provide lumber for support or attachment of other construction including cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. **Size and Shape.** Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. **Moisture Content.** Nineteen percent maximum for lumber items not specified to receive wood preservative treatment.

D. **Grade.** Standard grade light framing size lumber or No. 2 Boards per SPIB rules.

2.5 FASTENERS

A. **General.** Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners with a hot dip zinc coating per ASTM A 153.

B. Nails, Wire, Brads, and Staples. FS FF-N-105.

C. **Power Driven Fasteners.** National Evaluation Report NER-272.

D. **Wood Screws.** ANSI B18.6.1.

E. **Lag Bolts.** ANSI B18.2.1.

F. **Bolts.** Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.6 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

A. **General.** Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.

B. **Aboveground Items.** Pressure-treat aboveground items with waterborne preservatives to a minimum retention of 0.25 pound per cubic foot (pcf). For interior uses, after treatment, kiln dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following.

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

C. **Members in Contact with Ground.** Pressure-treat wood members in contact with the ground or fresh water with waterborne preservatives to a minimum retention of 0.40 pcf.

D. **Fabrication.** Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. **Unusable Material.** Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.

B. **Setting Rough Carpentry.** Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.

C. **Fitting Rough Carpentry.** Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. **Securement.** Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

E. **Nailing Exposed Carpentry.** Countersink nail heads on exposed carpentry work and fill holes.

F. **Nails.** Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. **General.** Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. **Attachment.** Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

3.3 DEMONSTRATION

A. **General.** Prior to commencement of the installation and/or application of interior and/or exterior finishes, the Contractor shall demonstrate to representatives of the Engineer/Architect (and/or Owner) that all framing and other rough carpentry members are installed at the indicated spacing, are of the indicated size and grade, and are fastened with the required anchors and fasteners, and that no members have been damaged during handling, fabrication, or installation.

1. Correct all noted deficiencies to the satisfaction of the Engineer/Architect's representative prior to commencing with finish work.

2. Demonstration and corrective measures may be phased to allow commencement of finish work according to the approved Construction Schedule.

END OF SECTION

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SECTION 06 80 01

COMPOSITE FABRICATIONS FOR BAFFLE WALLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide all labor, tools, equipment, and materials necessary to furnish and install, in proper operating condition, the fiberglass-reinforced plastic (FRP) baffle wall panel products and fabrications in accordance with the drawings and the specifications. Openings in the baffles, as shown on the drawings, shall be performed by the manufacturer. The baffle walls are subject to no differential in water surfaces and will be installed below grade in concrete clearwells chambers which require confined space entry during construction. The existing and proposed access manways to the clearwells are shown on the drawings; the proposed and existing access manways shall be used to lower panels into the clearwells for installation. The baffle walls are intended to direct the flow path of waters through each chamber in a multipass configuration as shown on the drawings.

1.3 QUALITY ASSURANCE.

A. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ISO 9001
2. ANSI – American National Standards Institute.
3. ASTM – American Society for Testing and Materials.
4. AWS – American Welding Society.
5. Rockwell Laboratories.
6. NSF-61
7. Specific standards shall include the following:

Method	**Test**	**Minimum Value**
ASTM D 638	Tensile Strength	40,000 psi
ASTM D 790	Flexural Strength	32,000 psi
ASTM D 790	Flexural Modulus	8 x10^5 psi
ASTM D 2583	Barcol Hardness	50
ASTM D695	Compressive Strength	50,000 psi
ASTM D 256	Notched 120D Impact	15 lbs/in

B. **Certified Tests**. Furnish the Owner with certified test reports of the physical and mechanical properties of the product. Each panel shall have the minimum physical properties specified herein. Flexural properties shall be measured with the resin-rich upper surface in compression. Hardness tests shall be made on the resin-rich upper surface.

1.4 SUBMITTALS

A. Submit the following submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Shop Drawings, Product Data, and Design Criteria

1. Schedule. No products shall be delivered or installed before this submittal package has been reviewed and approved.

2. Submittal Package Contents.

a. Manufacturer's product data including material certifications on fiberglass-reinforced plastic material.

b. Shop Drawings including:

1) Manufacturer's name and model.

2) Dimensional layouts including sectional view, required clearances, and bolt and anchor locations.

3) Materials of construction.

4) Equipment specifications.

5) Weights.

6) Anchor bolts.

7) Bill of materials.

8) Installation instructions.

C. Submittal Package No. 2 – Equipment Installation Inspection Reports

1. Schedule. The operational demonstration cannot begin until these documents are approved.

2. Submittal Package Contents. Manufacturer's representative reports, in accordance with Section 01 75 00, from equipment installation inspection.

1.5 JOB CONDITIONS

A. **Interfacing**. Coordinate clearance of any composite clarifier equipment with clarifier equipment manufacturer.

B. **Environment Requirements.** The equipment shall be designed for operation in a potable water storage tank with a chlorine residual of approximately 2 mg/L.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle the composite fabrications in accordance with Section 01 60 00 and the manufacturer's instructions

1.7 SPECIAL WARRANTY

A. The manufacturer shall warrant that all composite fabrications furnished under this specification shall be free of defects in materials and workmanship for a period of 2 years from the date of acceptance.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

A. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/100 of span for structural members. Connections shall be designed to transfer loads.

B. Baffle walls shall be self supporting when tank is empty.

C. The connections shall be designed to retain the baffles while the tank is full.

2.2 MATERIALS

A. **Mold each fabrication of FRP**. The resins and fiberglass reinforcing material shall be consistent with the environmental conditions and structural requirements. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification and certified as meeting the manufacturer's approved list of raw materials. The panels shall be manufactured using the pultrusion process. A minimum 7 mil. synthetic surface veil shall be the outermost layer covering the exterior surface.

B. **Baffle panels.** The FRP baffles shall be ribbed profile in 4" depth. The baffle panels shall be a minimum of ¼" thick. The FRP baffle panels shall have top horizontal ribs that slope downward not less than 10 degrees to minimize sediment build-up.

C. **Columns.** Columns shall be standard FRP sections; spaced at no more than 10 feet or as shown on the plans. Columns shall be notched to allow for installation/ removal of the baffle panel sections after columns are installed.

D. **Visual quality.** The visual quality of the pultruded shapes shall conform to ASTM D4385.

E. **All exposed surfaces** shall be smooth and true to form in compliance with ASTM D4385.

F. **Hardware**. All fasteners, anchors, and structural hardware shall be 316 stainless steel.

G. **All connections** of Baffle Wall Panels to fiberglass columns or super structure shall be as shown on the approved shop drawings.

2.3 ACCESSORIES.

A. **Furnish anchors** in accordance with Section 05 05 23, "Anchors."

B. Furnish all other fasteners and mounting brackets in Type 316 stainless steel

2.4 MANUFACTURER.

A. **All composite fabrications** shall be supplied by the same manufacturer.

B. **Subject to compliance with the specifications**, provide the composite fabrications from one of the following approved manufacturers.

1. Strongwell
2. MFG Laminating Group
3. Enduro Composites
4. NEFCO
5. Or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Field verify that surfaces and site conditions are ready to receive work and the following conditions:

1. Existing concrete tank and collector have been cleaned and are ready for equipment to be placed.
2. All dimensions and clearance of related equipment.

B. **Responsibility**. Beginning the installation means the installer accepts the existing surfaces and conditions.

3.2 PREPARATION.

A. Complete preparatory work in accordance with manufacturer's instructions prior to equipment installation.

B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

C. The concrete wall surface onto which the baffle wall is mounted shall be smooth with no protrusions. Rubbing of these concrete surfaces may be required prior to installation.

3.3 INSTALLATION

A. Requirements. Fabricate and install the composite fabrications as shown, as specified herein, in accordance with the approved shop drawings and the manufacturer's instructions and recommendations.

B. The Contractor shall field verify existing dimensions and install the baffle walls in accordance with the contract drawings, approved shop drawings and manufacturer’s recommendations. Contractor shall provide footings or grout pads for structure if required.

C. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as recommended by the manufacturer.

D. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.

E. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

F. All field cut and drilled edges, holes and abrasions shall be sealed with a sealant compatible with the original resin as recommended by the manufacturer.

G. Install items specified as indicated and in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Notify and coordinate with the equipment manufacturer in a timely manner in order for them to conduct their required inspection, as required in this specification section. This shall be done at no additional cost to the Owner.

B. **Manufacturer's Representative**. A qualified representative of the equipment manufacturer shall inspect the completed installation and provide the Owner with a written certificate of approval in accordance with Section 01 33 00. The representative shall spend at least 2 hours performing the required services and submit a manufacturer's representative report as specified in Section 01 75 00.

C. **Defective Work**. If defects are found, take corrective procedures at no additional cost to the Owner.

PART 4 EQUIPMENT SCHEDULE

4.1 Baffle Walls

A. Clearwell and Chlorine Contact Tanks

Tanks	**Walls**
Clearwell Chamber No. 1A	69'-6"x15'H
Clearwell Chamber No. 2B	69'-6"x15'H
New Chlorine Contact Tank No .1	9'-6"x15'H & 36'-6"x15'H
New Chlorine Contact Tank No. 2	9'-6"x15'H & 33'-1-1/2"x15'H

4.2 Note: The height of the wall is 15', but columns will have to be 19' high to accommodate the attachment of the column to the clearwell ceiling.

END OF SECTION

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SECTION 07 01 50.19

PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. **Section Includes:**

1. Full tear-off of entire roof where indicated.

1.2 DEFINITIONS

A. **Roofing Terminology:** Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

B. **Roof Re-Cover Preparation:** Existing roofing system is to remain and be prepared for new roof installed over it.

C. **Full Roof Tear-Off:** Removal of existing roofing system from deck.

1.3 ACTION SUBMITTALS

A. **Product Data:** For each type of product.

B. **Temporary Roofing Submittal:** Product data and description of temporary roofing system. If **temporary** roof remains in place, include surface preparation requirements needed to receive permanent roof, and submit a letter from roofing manufacturer, stating acceptance of the temporary roof and that its inclusion does not adversely affect the roofing system's resistance to fire and wind.

1.4 INFORMATIONAL SUBMITTALS

A. **Photographs or Videotape**: Show existing conditions of adjoining construction and site **improvements**, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

1.5 QUALITY ASSURANCE

A. **Installer Qualifications:** Approved by warrantor of existing roofing system to work on existing roofing.

B. **Reroofing Conference:** Conduct conference at Project site.

1.6 **FIELD CONDITIONS**

A. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations are not disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.

1. Coordinate work activities daily with Owner so Owner can place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.

2. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.

B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

D. Limit construction loads on roof to 250 for rooftop equipment wheel loads and 25 psf for uniformly distributed loads.

E. **Weather Limitations:** Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

PART 2 - PRODUCTS

2.1 INFILL AND REPLACEMENT MATERIALS

A. Use infill materials matching existing roofing system materials unless otherwise indicated.

2.2 AUXILIARY REROOFING MATERIALS

A. **General**: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shut off rooftop utilities and service piping before beginning the Work.

B. Protect existing roofing system that is not to be reroofed.

C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

D. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use

roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

3.2 ROOF TEAR-OFF

A. **General**: Notify Owner each day of extent of roof tear-off proposed for that day.

B. Remove aggregate ballast from roofing.

C. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing using a power broom.

D. **Full Roof Tear-Off:** Remove existing roofing and other roofing system components down to the deck.

1. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen, unadhered felts, and wet felts.

2. Remove excess asphalt from steel deck. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.

3. Remove fasteners from deck.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or by pouring 1 pint (0.5 L) of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if moisture condenses under plastic sheet or if asphalt test sample foams or can be easily and cleanly stripped after cooling.

C. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect. Do not proceed with installation until directed by Architect.

D. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

3.4 INFILL MATERIALS INSTALLATION

A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.

B. Install new roofing patch over roof infill area. If new roofing is installed the same day tear-off is made, roofing patch is not required.

3.5 BASE FLASHING REMOVAL

A. **Remove** existing base flashings. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

3.6 DISPOSAL

A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION

SECTION 07 10 00

WATERPROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and apply the waterproofing in accordance with the drawings and as specified herein.

B. **Masonry**. Waterproof all exterior masonry.

C. **Concrete**. Waterproof concrete where shown or called for.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work to furnish and apply the waterproofing in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in conformance with the following standards referenced herein.

1. ASTM – American Society for Testing and Materials.
2. COE – U.S. Army Corps of Engineers.
3. NSF – National Sanitation Foundation.
4. Ohio EPA – Ohio Environmental Protection Agency.

C. **Test**. A small area of the surface to be waterproofed shall be tested and accepted prior to application of the waterproofing to the entire surface.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's technical data and installation instructions for each type of waterproofing. Technical data shall show manufacturer's trade name, color, all independent laboratory tests, performance data, method of application, storage requirements, safety fact sheet, container sizes, and mixing instructions.

B. **Samples**. Submit a 1-foot-square sample of membrane waterproofing.

C. **Special Warranty**. Submit special warranty as specified in Item 1.7 of this specification.

D. Certification

1. Contractor. Certify in writing that all waterproofing has been applied in conformance with the manufacturer's instructions.
2. Manufacturer. Manufacturer shall submit in writing that preparation, installation, and protection of the waterproof membrane have been inspected and met with their approval.

E. **Conditions**. Submit, in writing, surface conditions detrimental to proper installation/application of waterproofing. Do not commence with work until the listed items are corrected.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate all work with other trades to prevent delays, omissions, damage, and/or interference with other work.

B. Environmental Conditions

1. Climatic. Perform no work when the ambient air temperature is below 40 degrees Fahrenheit (° F.) and/or the material surface to be coated is less than 50° F. or greater than 90° F.

C. **Protection**. Protect all surfaces not to be waterproofed from spillage, dripping, or splattering of the waterproofing material. Repair or replace any damage.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Waterproofing shall be delivered to the site in sealed containers bearing a label which shall list the manufacturer's name, trade name, application rate, precautionary methods required, and mixing ratio.

B. **Storage**. Store materials in an enclosed dry area, protected from damage. Keep storage areas clean and neat at all times.

C. **Handling**. Handle material as recommended by the manufacturer.

1.7 **SPECIAL WARRANTY**. The manufacturer shall provide a 10-year written warranty against moisture penetration on all waterproofed areas.

PART 2 PRODUCTS

2.1 MATERIAL

A. Liquid-Applied Waterproofing

1. Concrete Surfaces.

a. Waterproofing for concrete surfaces shall be a liquid compound that will react with the alkali and moisture in the concrete to produce a gel within the concrete and bind it into a solid mass producing a higher density, higher strength, and a permanent water seal. Waterproofing shall be clear, colorless, odorless, nonflammable, nonpoisonous, noninjurious to the skin, nontoxic, and tasteless, and shall not react with wood, asphalt, tar, metal, or asbestos. Concrete waterproofing shall meet:

1) ASTM C 267, "Chemical Resistance of Mortars."

2) ASTM C 672, "Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals."

3) COE, "Permeability of Concrete."

4) Ohio EPA, "List of Approved Materials in Contact with Potable Water."

5) NSF, "Approval for Contact with Potable Water."

b. Products/Manufacturers.

1) Evercrete-DPS by Evercrete Co., Las Vegas, Nevada.

2) Xypex by Xypex Chemical Co., Richmond, B.C., Canada.

3) Or equal.

2. Brick and Stone Surfaces.

a. Waterproofing for brick and stone surfaces shall be a clear, colorless, liquid compound capable of 97 percent repellency for water immersion test at 70 degrees Fahrenheit (^{o} F.) for 30 minutes. Brick and stone waterproofing shall meet:

1) ASTM C 67, "Absorption Test for Brick."

2) ASTM E 514, "Water Permeance Test of Masonry."

3) ASTM D 1653, "Moisture Vapor Transmission Rate."

b. Products/Manufacturers.

1) Hydrozo Clear Double 7 by Hydrozo Coatings, Lincoln, Nebraska.

2) Evercrete TS by Evercrete Co., Las Vegas, Nevada.

3) Or equal.

3. Concrete Block Surfaces.

a. Waterproofing for concrete block shall be a copolymer of plastic resins in emulsion form containing color pigments, selected mica fillers, and silicone with a minimum vapor transmission rate of 3.5 grams per 100 square inches per 24 hours. Waterproofing shall be resistant and colorfast to industrial fumes, water, and humidity.

b. Products/Manufacturers.

1) Hydrocide Super Color Coat by Sonneborn Building Products, Maspeth, New York.

2) Or equal.

B. MEMBRANE-APPLIED WATERPROOFING

1. Membrane.

a. Wall Membrane. Waterproofing membrane shall be a factory-made composite product with a minimum thickness of 60 mils and consisting of 56 mils of rubberized asphalt and 4 mils of cross-laminated polyethylene film. The membrane shall be self-adhesive and cold-applied. The rubberized asphalt shall be factory-protected with a release paper that is removed at the time of installation.

b. Under-Slab Membrane. Membrane for waterproofing under slabs shall be factory-made composite product of rubberized asphalt and an inert reinforcing scrim for a total of 65 to 70 mils.

2. Surface Conditioner. Concrete surface conditioner shall be water-based, spray- or roll-applied to produce a dust-free surface to ensure positive adhesion.

3. Mastic. As recommended by the waterproofing membrane manufacturer.

4. Protective Board.

   a. Polystyrene. One-inch-thick expanded polystyrene, with normal density of 1.0 pound per cubic foot meeting an "R" value of 4 per inch of thickness at 75° F.

   b. Asphaltic. Premolded semirigid board consisting of bitumen, mineral core, and reinforcement scaled under heat and pressure. Thickness of protective board shall be as recommended by the manufacturer, but not less than 1/4 inch.

5. Adhesive. Protective panel adhesive shall be as recommended by the manufacturer.

6. Manufacturer. Waterproofing membrane shall be Bituthene by W.R. Grace and Company, Aquasel by J&P Petroleum Products, Inc., or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Examine the surface to receive the waterproofing, and the conditions under which the waterproofing work is to be performed, and notify the Engineer/Architect in writing of any conditions detrimental to the proper and timely completion of the work and performance of the waterproofing. Do not proceed with the waterproofing work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation

1. All concrete shall be dry and cured a minimum of 7 days.

2. Keep surface free of dirt, mortar, concrete protrusions, oil, and foreign material; grind all projections smooth.

3. Prepare surfaces in accordance with manufacturer's recommendation.

4. Fill voids and tie holes, seal joints, and apply bond breakers as recommended by the manufacturer.

5. Install separate flashing as recommended by the manufacturer.

6. Prime the substrate as recommended by the manufacturer.

3.3 APPLICATION

A. Liquid-Applied

1. Apply liquid-applied waterproofing by brush, roller, or spray in accordance with the manufacturer's instructions to form a continuous sheath free of skips, pinholes, holidays, and other imperfections. The maximum area of coverage for a unit volume shall be as recommended by the manufacturer.

2. Number of Coats.

a. Concrete Surfaces. Minimum of two coats.

b. Brick and Stone Surfaces. Minimum of one coat.

c. Concrete Block Surfaces. Minimum of two coats for a final dry film thickness of 15 to 20 mils.

B. Membrane-Applied

1. Priming.

a. Apply surface conditioner at the dilution and rate recommended by the manufacturer. Recoat areas contaminated by dust.

b. Mask off and protect adjoining finished surfaces from excessive application of surface conditioner.

c. Surface conditioner to be completely dry prior to application of membrane.

2. Membrane.

a. Apply membrane in lengths up to 8 feet. Overlap all seams at least 2-1/2 inches. On higher walls apply membrane in two or more sections with the upper overlapping the lower by at least 2-1/2 inches. Two plies of membrane are recommended for applications on any wood surfaces. Roll all membrane with a hand roller.

b. Terminate the membrane at grade level. Press the membrane firmly to the wall with a hardwood tool such as a hammer handle or secure into a reglet. Failure to use heavy pressure at terminations can result in a poor seal. Seal the termination with mastic or liquid membrane.

c. Terminate the membrane on the top of the footing if the vertical waterproofing ties into the mud slab waterproofing or if the elevation of the interior floor slab is less than 6 inches above the footing. Extend the membrane at least 6 inches onto the mud slab waterproofing and terminate with mastic or liquid membrane. Seal all laps within 12 inches of the corner with mastic or liquid membrane.

d. Protect all joints, vertical and horizontal, construction and expansion, with two layers of waterproofing membrane. First layer shall be not less than 12 inches, second layer not less than 18 inches wide. Each strip shall be centered over the joint.

e. Seal all daily terminations with a thin troweled bead of mastic or liquid membrane.

3. Protective Board.

a. Apply protective board in accordance with manufacturer's recommendations prior to backfilling.

3.4 FIELD QUALITY CONTROL

A. Backfilling

1. Do not backfill liquid-sealed concrete for a minimum of 7 days or as directed by the manufacturer.

2. Do not backfill membrane sealed concrete surfaces until all the membrane has been checked, repaired, and/or replaced and the protective board is in place.

B. **Painting**. Do not paint liquid sealed concrete surfaces until 21 days after sealing. Clean prior to painting in strict accordance with the manufacturer's instructions.

C. **Inspection and Repair**. Inspect membrane thoroughly before covering and make any corrections immediately. Patch tears and inadequately lapped seams. Slit fishmouths and repair with a patch extending 6 inches in all directions from the slit and seal edges of the patch with mastic.

3.5 DEMONSTRATION

A. **Visual**. With the Owner and/or Engineer/Architect, visually review the waterproofing work for completion.

1. Membrane System.

a. Membrane System. Check the membrane for laps, areas covered, tears, bubbles, etc., prior to application of the protective board, cover, or other surface over the membrane.

b. Prior to backfilling, visually check the protective board for complete coverage of the membrane.

2. Liquid. Water-spray all surfaces waterproofed under full hose nozzle pressure of 40 pounds per square inch (psi). Check surface with a meter, visual balling of surface water, or with plastic test patch.

END OF SECTION

SECTION 07 21 00

BUILDING INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide all labor, materials, tools, and equipment necessary to furnish and install building insulation in accordance with the plans and as specified herein.

B. **Work Included.** This section includes the following:

1. Insulation under slabs-on-grade.
2. Block/board cavity wall insulation.
3. Concealed building insulation in board form.
4. Exposed building insulation in board form.
5. Building insulation in batt form.

C. **Related Sections.** The following sections contain requirements that relate to this section:

1. Division 4 Masonry for polystyrene board insulation installed in cavity walls and masonry cells.
2. 2.Division 7 Thermal and Moisture Protection for roof insulation specified as part of roofing construction.

1.3 QUALITY ASSURANCE

A. **Codes.** Perform all work in compliance with all federal, state, and local codes.

B. **Standards.** Materials and workmanship shall be in accordance with the following standards:

1. ASTM - American Society for Testing and Materials
2. FS - Federal Specifications.
3. UL - Underwriters' Laboratories, Inc.

C. **Regulatory Agencies.** Perform all work in compliance with the requirements of the following regulatory agencies:

1. OSHA - Occupational Safety and Health Administration.
2. ADA - Americans with Disabilities Act.

D. **Fire Performance Characteristics.** Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristic. ASTM E 84.

2. Fire Resistance Ratings. ASTM E 119.

3. Combustion Characteristics. ASTM E 136.

E. **Single-Source Responsibility for Insulation Products.** Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.

1.4 SUBMITTALS

A. **General.** Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for each type of insulation product specified.

2. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence compliance of plastic foam insulations with building code in effect for project.

1.5 JOB CONDITIONS

A. **Coordination - Interfacing.** Coordinate with all other trades to prevent delays, errors, and omissions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General.** Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

B. **Plastics.** Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time.

3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 SPECIAL WARRANTY (Not Used)

1.8 DEFINITIONS

A. **Thermal Resistivity.** Where the thermal resistivity of insulation products is designated by "r-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity is expressed by the temperature difference in degrees Fahrenheit (º F.) between the two exposed faces required to cause one British thermal unit (Btu) to flow through 1 square foot per hour at mean temperatures indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:

1. Extruded Polystyrene Board Insulation.
    a. Amoco Foam Products Co.
    b. DiversiFoam Products.
    c. Dow. The Dow Chemical Company.
    d. UC Industries, Inc.
2. Polyisocyanurate Board Insulation.
    a. Celotex. Building Products Div., The Celotex Corporation.
3. Manufacturers of Glass Fiber Insulation.
    a. CertainTeed Corp.
    b. Knauf Fiber Glass GmbH.
    c. Manville. Building Insulations Div., Manville Sales Corp.
    d. Owens/Corning Fiberglas Corp.
4. Manufacturers of Semi-refractory Fiber Insulation.
    a. Cafco Industries Ltd.
    b. Fibrex Inc.
    c. USG. Thermafiber Div., USG Interiors, Inc.

2.2 INSULATING MATERIALS

A. **General.** Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units. Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

B. **Extruded Polystyrene Board Insulation.** Rigid, cellular polystyrene thermal insulation with closed cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578 for type indicated; with 5 year aged r-values of 5.4 and 5 at 40 and 75º F. (4.4 and 23.9 degrees Celsius [º C.]), respectively; and as follows:

1. Type IV, 1.6 pounds per cubic foot (pcf) minimum density, unless otherwise indicated.
2. Type V, 3.0 pcf minimum density where indicated.
3. Type VI, 1.8 pcf minimum density.
4. Type VII, 2.2 pcf minimum density.
5. Type X, 1.35 pcf minimum density.

6. Surface Burning Characteristics. Maximum flame spread and smoke developed values of 75 and 450, respectively.

C. **Polyisocyanurate Board Insulation.** Rigid, cellular thermal insulation with glass fiber reinforced polyisocyanurate closed cell foam core and manufacturer's recommended ½" coverboard on the other; complying with FS HH-I-1972/1, Class 2; aged r-values as indicated, respectively:

D. **Faced Mineral Fiber Blanket/Batt Insulation.** Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type III, Class A (blankets with reflective vapor retarder membrane facing with flame spread of 25 or less); foil scrim kraft or foil scrim polyethylene vapor retarder membrane on one face, and as follows:

1. Mineral Fiber Type. Fibers manufactured from glass or slag.

2. Surface Burning Characteristics. Maximum flame spread and smoke developed values of 25 and 50, respectively.

3. Flanged Units. Provide blankets/batts fabricated with facing incorporating 4-inch-wide flanges along their edges for attachment to framing members.

2.3 AUXILIARY INSULATING MATERIALS

A. **Adhesive for Bonding Insulation.** Product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding either insulation, anchors, or substrates.

B. **Eave Ventilation Troughs.** Preformed rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions.** Examine substrates and conditions with installer present, for compliance with requirements of the sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Cleaning.** Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections that might puncture vapor retarders.

3.3 INSTALLATION

A. **General.** Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

B. **Continuity of Insulation.** Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.

C. **Layers.** Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER AND UNDER SLAB INSULATION

A. **Vertical Surfaces.** On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type of adhesive recommended by manufacturer of insulation.

B. **Top Surface Protection.** Protect top surface of horizontal insulation (from damage during concrete work) by application of protection board.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

A. **General.** Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. **Treatment of Joints and Voids.** Seal joints between closed cell (non-breathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. **Vapor Retarder.** Set vapor retarder faced units with vapor retarder to warm side of construction, except as otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.

1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. **Foil-Faced Units.** Set reflective, foil-faced units accurately with not less than 0.75 inch air space in front of foil as indicated.

E. **Voids and Cavities.** Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf.)

3.6 PROTECTION

A. **General.** Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.7 DEMONSTRATION

A. **Correct all noted deficiencies** to the satisfaction of the Engineer/Architect's representative prior to commencing with placement of concrete slabs, backfill, sheathing, interior and/or exterior finishes and other systems.

END OF SECTION

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SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS.

A. **Drawings** and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. **Section includes** fluid-applied, vapor-retarding membrane air barriers.

1.3 ACTION SUBMITTALS

A. **Product Data**: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. **Shop Drawings**: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. **Product Certificates:** From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. **Product Test Reports:** For each air-barrier assembly, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Remove and replace liquid materials** that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

A. **Environmental Limitations**: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that effect air-barrier performance.

2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

A. **Source Limitations**: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. **General**: Air barrier shall be capable of performing as a continuous vapor-**retarding** air barrier. Air-barrier **assemblies** shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. **Air-Barrier Assembly Air Leakage**: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 283, ASTM E 783, or ASTM E 2357.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

A. **Fluid-Applied, Vapor-Retarding Membrane Air Barrier**: Elastomeric, modified bituminous or synthetic **polymer** membrane.

3. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.

b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E 96/E 96M.

c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

2.4 ACCESSORY MATERIALS

A. **General**: **Accessory** materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. **Primer**: **Liquid** primer recommended for substrate by air-barrier material manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. **Examine substrates, areas, and conditions,** with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

2. Verify that substrate has cured and aged for minimum time period recommended by air-barrier manufacturer.

3. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

1) Verify that masonry joints are flush and completely filled with mortar.

B. **Proceed with installation** only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. **Clean, prepare, treat, and seal** substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. **Mask off adjoining surfaces** not covered by air barrier to prevent spillage and overspray affecting other construction.

C. **Remove grease,** oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. **Remove fins,** ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. **Remove excess mortar** from masonry ties, shelf angles, and other obstructions.

F. **At changes in substrate plane,** apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. **Cover gaps** in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. **Concrete and Masonry**: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches (75 mm) along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

3.4 TRANSITION STRIP INSTALLATION

A. **General**: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

B. **Apply primer to substrates** at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

C. **Connect and seal exterior wall air-barrier material** continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. **Fill gaps in perimeter frame surfaces** of windows, curtain walls, storefronts, and doors, and miscellaneous **penetrations** of air-barrier material with foam sealant.

E. **Seal strips and transition strips** around masonry reinforcing or ties and penetrations with termination **mastic**.

F. **Repair punctures, voids, and deficient lapped seams** in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. **General:** Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a **continuous** air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.

B. **Membrane Air Barriers**: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as **masonry** ties.

1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness, applied in one or more equal coats.

3.6 FIELD QUALITY CONTROL

A. **Inspections**: **Air**-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.

2. Continuous structural support of air-barrier system has been provided.

3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.

4. Site conditions for application temperature and dryness of substrates have been maintained.

5. Maximum exposure time of materials to UV deterioration has not been exceeded.

6. Surfaces have been primed, if applicable.

7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.

8. Termination mastic has been applied on cut edges.

9. Strips and transition strips have been firmly adhered to substrate.

10. Compatible materials have been used.

11. Transitions at changes in direction and structural support at gaps have been provided.

12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.

13. All penetrations have been sealed.

B. **Air barriers will be considered defective** if they do not pass tests and inspections.

14. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.

15. Remove and replace deficient air-barrier components for retesting as specified above.

C. **Repair damage to air barriers** caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. **Protect air-barrier system from damage** during application and remainder of construction period, according to manufacturer's written instructions.

16. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.

17. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. **Clean spills, stains, and soiling from construction** that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

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SECTION 07 53 23

ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings** and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. **Section Includes:**

1. Adhered ethylene-propylene-diene-monomer (EPDM) roofing system.
2. Vapor retarder.
3. Roof insulation.

B. **Related Requirements:**

1. Section 06 10 00 "Rough Carpentry" for wood nailers and blocking.

1.3 DEFINITIONS

A. **Roofing Terminology:** Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. **Preinstallation Roofing Conference:** Conduct conference at Project site.

1. Meet with Owner, Engineer/Architect, Owner's insurer if applicable, testing and inspecting agency representative, Contractor, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. **Product Data**: For each type of product.

B. **Shop Drawings:** For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
1. Base flashings and membrane terminations.
2. Roof plan showing orientation of roof deck and orientation of roofing.
3. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

1.6 INFORMATIONAL SUBMITTALS

A. **Qualification Data:** For Installer and manufacturer.

B. **Manufacturer Certificates:** Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
1. Submit evidence of complying with performance requirements.

C. **Product Test Reports:** For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

D. **Research/Evaluation Reports:** For components of roofing system, from ICC-ES.

E. **Field quality-control reports.**

F. **Sample Warranties:** For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. **Maintenance Data:** For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. **Manufacturer Qualifications:** A qualified manufacturer that is capable of producing a roofing system identical to that used for this Project.

B. **Installer Qualifications:** A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. **Deliver roofing materials** to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. **Store liquid materials** in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. **Protect roof insulation materials** from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. **Handle and store roofing materials**, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. **Weather Limitations:** Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. **Special Warranty:** Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, walkway products and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. **Special Project Warranty:** Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Source Limitations:** Obtain components including roof insulation and fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. **General Performance:** Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. **Material Compatibility:** Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. **FM Global Listing:** Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: SH.

D. **Exterior Fire-Test Exposure:** ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 EPDM ROOFING

A. **EPDM**: ASTM D 4637, Type I, nonreinforced, uniform, flexible EPDM sheet.

1. Subject to compliance with the requirements, provide products by one of the following manufacturers.

    a. Carlisle SynTec
    b. Firestone Building Products
    c. Johns Manville (Basis of Design)
    d. Mule-Hide Products

2. Thickness: 60 mils (1.5 mm), nominal.

3. Exposed Face Color: Black.

2.4 AUXILIARY ROOFING MATERIALS

A. **General**: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. **Sheet Flashing:** 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. **Bonding Adhesive:** Manufacturer's standard.

D. **Seaming Material:** Single-component, butyl splicing adhesive and splice cleaner or manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

E. **Lap Sealant:** Manufacturer's standard, single-component sealant, colored to match membrane roofing].

F. **Water Cutoff Mastic:** Manufacturer's standard butyl mastic sealant.

G. **Metal Termination Bars:** Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

H. **Metal Battens:** Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

I. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

J. **Miscellaneous Accessories:** Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.5 VAPOR RETARDER

A. **Self-Adhering-Sheet Vapor Retarder:** ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- (1.0-mm-) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.6 ROOF INSULATION

A. **General:** Preformed roof insulation boards manufactured or approved by EPDM roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

B. **Polyisocyanurate Board Insulation:** ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

C. **Provide preformed saddles**, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

D. **Gypsum Cover Board.** Securock Roof Board Primed, DensDeck Roof Board with Eonic Technology, Or Approved Equal.

1. Qualities: Nonstructural, noncombustible, homogenous composition panel.
2. Board Size: Four by eight feet (4'x8').
3. Thickness: One half (1/2) inch.
4. R-Value: .5
5. Compliances: UL. WH or FM listed under Roofing Systems.
6. Manufacturer: USG, Georgia-Pacific (GP), Or Approved Equal

2.7 INSULATION ACCESSORIES

A. **General**: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. **Fasteners**: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

2.8 WALKWAYS

A. **Flexible Walkways:** Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine** substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place and curbs are set and braced.
2. Verify that wood blocking and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that compounds that will impair adhesion of roofing components to roof deck have been removed.

B. **Proceed** with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Clean** substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. **Prevent** materials from spilling or migrating onto surfaces of other construction.

3.3 ROOFING INSTALLATION, GENERAL

A. **Install** roofing system according to roofing system manufacturer's written instructions.

B. **Complete terminations** and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 VAPOR-RETARDER INSTALLATION

A. **Self-Adhering-Sheet Vapor Retarder**: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches (90 mm) and 6 inches (150 mm), respectively. Seal laps by rolling.

B. **Completely seal** vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.5 INSULATION INSTALLATION

A. **Coordinate** installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. **Comply** with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. **Install insulation under** area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

D. **Trim surface of insulation** where necessary so completed surface is flush and does not restrict flow of water.

E. **Install insulation** with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

F. **Mechanically Fastened and Adhered Insulation:** Install insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type and set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

1. Fasten and adhere insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

A. **Adhere roofing over area** to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

B. **Start installation** of roofing in presence of roofing system manufacturer's technical personnel.

C. **Accurately align roofing**, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. **Bonding Adhesive:** Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. **In addition to adhering**, mechanically fasten roofing securely at terminations, penetrations, and perimeters.

F. **Apply roofing** with side laps shingled with slope of roof deck where possible.

G. **Adhesive Seam Installation:** Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

H. **Tape Seam Installation:** Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing according to manufacturer's

written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

I. **Repair** tears, voids, and lapped seams in roofing that do not comply with requirements.

J. **Spread** sealant or mastic bed over deck-drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

A. **Install sheet flashings** and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. **Apply bonding adhesive** to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. **Flash penetrations** and field-formed inside and outside corners with cured or uncured sheet flashing.

D. **Clean splice areas**, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. **Terminate and seal** top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 WALKWAY INSTALLATION

A. **Flexible Walkways:** Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. **Testing Agency:** Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. **Final Roof Inspection:** Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. **Repair** or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. **Additional testing and inspecting,** at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

A. **Protect** membrane roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. **Correct deficiencies** in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. **Clean overspray and spillage** from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

A. **Warrany**.

WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner:
2. Address:
3. Building Name/Type:
4. Address:
5. Area of Work:
6. Acceptance Date: _____.
7. Warranty Period:
8. Expiration Date: _____.

AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding 105 mph;
    c. fire;

d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

Authorized Signature: _____.
Name: _____.
Title: _____.

END OF SECTION

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SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install flashing and sheet metal in accordance with the plans and as specified herein.

B. This section includes the following:

1. Metal counterflashing and base flashing (if any).
2. Metal wall flashing and expansion joints.
3. Built-in metal valleys, gutters, and scuppers.
4. Gutters and downspouts (rain drainage).
5. Exposed metal trim/fascia units.
6. Miscellaneous sheet metal accessories.
7. Elastic flashing.
8. Elastic roof/wall expansion joint systems.
9. Laminated and composition flashing.

C. **Integral masonry flashings are specified** as masonry work in sections of Division 4.

D. **Roofing accessories installed** integral with roofing membrane are specified in roofing system sections as roofing work.

E. **Roof accessory units of pre-manufactured**, set-on type are specified in Division 7 section "Roof Accessories."

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the flashing and sheet metal in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections.

1. Product Data, Flashing, Sheet Metal, and Accessories. Manufacturer's technical product data, installation instructions and general

recommendations for each specified sheet material and fabricated product.

2. Samples of the following flashing, sheet metal, and accessory items:

a. 8-inch-square samples of specified sheet materials to be exposed as finished surfaces.

1.5 JOB CONDITIONS

A. **Coordinate work of this section** with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM MATERIALS

A. **Zinc Coated Steel.** Commercial quality with 0.20 percent copper, American Society for Testing and Materials (ASTM) A 526 except ASTM A 527 for lock forming, G90 hot dip galvanized, mill phosphatized where indicated for painting; 0.0359 inch thick (20 gauge) except as otherwise indicated.

B. **Sheet Aluminum.** ASTM B 209, alloy 3003, temper H14, AA-C22A41 clear anodized finish; 0.032 inch thick (20 gauge) except as otherwise indicated.

C. **Extruded Aluminum.** Manufacturer's standard extrusions of sizes and profiles indicated, 60063-T52, AA-C22A41 clear anodized finish; 0.080 inch minimum thickness for primary legs of extrusions.

2.2 FLEXIBLE SHEET MEMBRANE FLASHING

A. **Elastic Sheet Flashing/Membrane.** Nonreinforced flexible, black elastic sheet flashing of 50 to 65 mils thickness and complying with the following:

1. Shore A Hardness (ASTM D 2240). 50 to 70.

2. Tensile Strength (ASTM D 412). 1,200 pounds per square inch (psi).

3. Tear Resistance (ASTM D 624, Die C). 20 pounds per linear inch.

4. Ultimate elongation (ASTM D 412). 250 percent.

5. Low Temperature Brittleness (ASTM D 746). -30 degrees Fahrenheit (º F.) (-35 degrees Celsius [º C]).

6. Resistance to Ozone Aging (ASTM D 1149). No cracks for 10 percent elongated sample for 100 hours in 50 parts per hundred million (pphm) (50.5 millipascal [mPa]) ozone at 104º F. (70º C.).

7. Resistance to Heat Aging (ASTM D 573). Maximum hardness increase of 15 points, elongation reduction of 40 percent, and tensile strength reduction of 30 percent, for 70 hours at 212º F. (100º C.).

B. Acceptable Products

1. Neoprene synthetic rubber sheet.

2. Butyl synthetic rubber sheet.

3. EPDM synthetic rubber sheet.

2.3 LAMINATED COMPOSITION SHEET FLASHING

A. **Copper/Paper Flashing.** 3-ounce copper sheet laminated between two sheets of bituminous impregnated creped Kraft paper or saturated fabric.

B. **Available Products.** Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

1. Afco Products, Inc.; Cop-A-Bond Duplex.

2. Phoenix Building Products, Inc.; Duplex Cop-R Flash.

3. York Manufacturing, Inc.; Cop-R-Tex Duplex.

C. Miscellaneous Materials and Accessories

D. **Solder.** For use with steel or copper, provide 50-50 tin/lead solder (ASTM B 32), with rosin flux.

E. **Fasteners.** Same metal as flashing/sheet metal or other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

F. **Bituminous Coating.** SSPC - Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15 mil dry film thickness per coat.

G. **Mastic Sealant.** Polyisobutylene; non-hardening, non-skinning, nondrying, nonmigrating sealant.

H. **Elastomeric Sealant.** Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 section "Joint Sealers."

I. **Epoxy Seam Sealer.** Two part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.

J. **Adhesives.** Type recommended by flashing sheet manufacturer for waterproof/weather resistant seaming and adhesive application of flashing sheet.

K. **Paper Slip Sheet.** 5-pound rosin sized building paper.

L. **Polyethylene Underlayment.** Minimum 6-mil carbonated polyethylene film resistant to decay when tested in accordance with ASTM E 154.

M. **Reglets.** Metal or plastic units of type and profile indicated, compatible with flashing indicated, noncorrosive.

N. **Metal Accessories.** Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gauge required for performance.

O. **Cast Iron Drainage Boots.** Grey iron castings of size and pattern indicated, ASTM A 48, bituminous shop coated.

P. **Gutter and Conductor Head Guards.** 20 gauge bronze or nonmagnetic stainless steel mesh or fabricated units, with selvaged edges and noncorrosive fasteners. Select materials for compatibility with gutters and downspouts.

Q. **Elastic Flashing Filler.** Closed cell polyethylene or other soft closed cell material recommended by elastic flashing manufacturer as filler under flashing loops to ensure movement with minimum stress on flashing sheet.

R. **Roofing Cement.** ASTM D 2822, asphaltic.

2.4 FABRICATED UNITS

A. **General Metal Fabrication.** Shop fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

B. **Seams.** Fabricate nonmoving seams in sheet metal with flat lock seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.

C. **Expansion Provisions.** Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

D. **Sealant Joints.** Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

E. **Separations.** Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

F. **Aluminum Extrusion Units.** Fabricate extruded aluminum running units with formed or extruded aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.

G. **Shop Finish, Rain Drainage.** Provide manufacturer's standard baked-on white acrylic shop finish on sheet metal rain drainage units (gutters, downspouts, and similar exposed units); 1.0-mil dry film thickness.

2.5 ELASTIC EXPANSION JOINTS

A. **General.** Provide factory fabricated units of size and profile indicated, complete with prefabricated corner units, intersection units, and splicing materials. Provide complete with elastic sheet flashing forming the primary joint membrane, in a supported, "bellows" arrangement designed for securement to both sides of expansion joints. Underside of bellows insulated with adhesively applied, flexible, closed cell rubber or plastic not less than 3/8 inch thick.

B. **Type.** Metal flanged edges, 3 to 4 inches wide, formed to profiles as indicated to fit curbs and designed for nailing to curb substrate. Provide metal flanges in the following thicknesses:

1. Zinc-Coated Steel. 0.0179 inch (26 gauge).
2. Aluminum. 0.032 inch.

C. **Looped Bellows Width.** 5 to 6 inches, exclusive of flanges.

D. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Afco Products, Inc.
2. Celotex Corporation.
3. International Permalite/Roofing Components Group.
4. Manville/Roofing Systems Division.
5. Phoenix Building Products, Inc.
6. York Manufacturing, Inc.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. **General.** Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. **Underlayment.** Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a slip sheet of red rosin paper and a course of polyethylene underlayment.

C. **Bed flanges of work in a thick coat** of bituminous roofing cement where required for waterproof performance.

D. **Install reglets to receive counterflashing** in manner and by methods indicated. Where shown in concrete, furnish reglets to trades of concrete work for installation as work of Division 3 sections. Where shown in masonry, furnish reglets to trades of masonry work, for installation as work of Division 4 sections.

E. **Install counterflashing in reglets**, either by snap-in seal arrangement or by welding in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.

F. **Install elastic flashing** in accordance with manufacturer's recommendations. Where required, provide for movement at joints by forming loops or bellows in width of flashing. Locate cover or filler strips at joints to facilitate complete drainage of water from flashing. Seam adjacent flashing sheets with adhesive, seal and anchor edges in accordance with manufacturer's recommendations.

G. **Nail flanges of expansion** joint units to curb nailers, at maximum spacing of 6 inches on center (o.c.). Fabricate seams at joints between units with minimum 3-inch overlap, to form a continuous, waterproof system.

3.2 CLEANING AND PROTECTION

A. **Clean exposed metal surfaces**, removing substances that might cause corrosion of metal or deterioration of finishes.

B. **Protection.** Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION

SECTION 07 71 00

MANUFACTURED ROOF SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install manufactured roof specialties in accordance with the plans and as specified herein.

B. This section includes the following:

1. Aluminum coping.

2. Elastic bellows-type roof expansion joint cover.

C. **Related Sections.** The following sections contain requirements that relate to this section:

1. Division 7 section "Roof Accessories" for the following work:

a. Roof hatches.

2. Division 7 section "Flashing and Sheet Metal" for the following work:

a. Metal flashing and counter flashing.

b. Elastic flashing.

c. Roof and wall expansion joints.

3. Roofing accessories installed integral with roofing membrane are specified in roofing system sections as roofing work.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install manufactured roof specialties in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1.4 SUBMITTALS

A. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data including manufacturer's technical data, installation instructions and general recommendations for each product specified. Include data substantiating that materials and performance comply with requirements.

2. Samples for initial selection purposes in form of manufacturer's sample finishes showing full range of colors and textures available for those units with factory applied color finishes.

1.5 JOB CONDITIONS

A. **Coordinate work of this section** with adjoining work for proper sequencing of each installation to ensure best possible weather resistance and protection of materials and finishes against damage.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY

A. **Special warranty.** All components shall be included with the roofing system warranty and shall be a single-source 20 Year Edge-to-Edge warranty provided by one manufacturer. Warranty shall include the roof systems, flashing, and the transition between all systems.

PART 2 PRODUCTS

2.1 MATERIALS

A. **Aluminum Extrusions.** Alloy and temper recommended by manufacturer for use intended and as required for proper application of finish indicated but not less than the strength and durability properties specified in ASTM B 221 for 6063-T5.

B. **Aluminum Sheet.** Alloy and temper recommended by manufacturer for use intended and as required for proper application of finish indicated but with not less than the strength and durability properties specified in American Society for Testing and Materials (ASTM) B 209 for 5005-H15.

2.2 MISCELLANEOUS ITEMS

A. **Exposed Fasteners.** Stainless steel, nonmagnetic, of type and size standard with manufacturer for product and application indicated. Match finish of exposed heads with material being fastened.

B. **Concealed Fasteners.** Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.

C. **Mastic Sealant.** Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

D. **Foam Rubber Seal.** Manufacturer's standard foam.

E. **Adhesives.** Type recommended by manufacturer for substrate and project conditions, and formulated to withstand minimum 60 pounds per square foot (psf) uplift force.

2.3 ALUMINUM COPING

A. **Interlocking Multipart Coping System.** Manufacturer's standard system consisting of coping formed from aluminum sheet to profile and of thickness indicated, 22-gauge minimum, zinc-coated steel anchor plate or cleat located at coping joint, and formed aluminum gutter chair or gutter/splice plate or compression pad/gutter; with prefabricated inside and outside corners, miters welded before finishing; without exposed fasteners.

1. Thickness of Coping. 0.050 inch.

2. Available Products. Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. Type AP Standard Coping; Architectural Products Co.

b. Rapid-Loc Coping; Atas Aluminum Corp.

c. Splice-Lock Coping Cover System; Cheney Flashing Co.

d. Permasnap Coping; W. P. Hickman Co.

e. Neo-Lock Coping; Merchant and Evans Industries, Inc.

f. Snap-Lok Coping; MM Systems Corp.

g. Pac-Loc Coping; Petersen Aluminum Corp.

h. Garland Roofing Products.

B. Premanufactured Snap On Flash-less Fascia. Manufacturer's standard system.

1. Thickness of Coping: 0.05

2. Available Products: Aluminum R-Mer Force Flass-less Snap-On Fascia Cover and Splice Plate, or approved equal.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. **Gutters.** Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Aluminum Sheet: 0.040 inch thick.

2. Gutter Profile: As indicated according to SMACNA's "Architectural Sheet Metal Manual."

3. Corners: Factory mitered mechanically clinched and sealed watertight.

4. Gutter Supports: Gutter brackets with finish matching the gutters.

B. **Downspouts.** Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Formed Aluminum: 0.040 inch thick.

2.5 ELASTIC, BELLOWS-TYPE EXPANSION JOINT COVERS

A. **General.** Provide units fabricated specifically for required applications (roof to roof. Provide prefabricated corner units, joint intersection units, splicing units, adhesives, coatings, and other components as recommended by joint unit manufacturer for a complete installation.

B. **Metal Flanged Elastic Sheet Joint System.** Provide units consisting of exposed elastic sheet over foam bellows, securely anchored at both edges to 3- to 4-inch-wide sheet metal nailing flanges, either plain or angle formed to fit curbs as required. Bellows insulated from below with adhesively applied, closed cell, flexible, rubber or plastic insulation not less than 5/16 inch thick, adhered to elastic sheet.

1. Elastic Sheet. EPDM, 60 mils.

2. Elastic Sheet Width. 5 to 6 inches between flanges.

3. Metal Flanges. Aluminum, minimum 0.032-inch thickness.

4. Available Products. Subject to compliance with requirements, products that may be incorporated in the work include but are not limited to the following:

a. Expansion Joint Shields; Celotex Corp.

b. Metalastic; International Permalite, Inc.

c. Expand-O-Flash; Manville Sales Corp.

d. Rufseal; MM Systems Corp.

e. Pate Expansion Joint Cover; The Pate Co.

f. Superflash; York Manufacturing, Inc.

2.6 FABRICATION

A. **General.** Provide items designed and fabricated to fit applications indicated and to perform optimally with respect to weather resistance, water tightness, durability, strength, and uniform appearance.

B. **Expansion Provisions.** Fabricate running lengths to allow controlled expansion not only for movement of metal components in relationship to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in a manner sufficient to prevent water leakage, deformation or damage.

2.7 ALUMINUM FINISHES

A. **General.** Comply with AMP 501 "Finishes for Aluminum" and AMP 505 "Applied Coatings" for finish designations and application recommendations, except as otherwise indicated. For components which are assembled or welded in factory, apply finish after fabrication is completed.

1. Provide colors or color matches as indicated or, if not indicated, as selected by Engineer/Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General.** Comply with manufacturer's written installation instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive work of this section, with vapor retarders, roof insulation, roofing membrane, flashing, and wall construction; as required to ensure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor products included in this section securely to structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. **Isolation.** Where metal surfaces of units are installed in contact with dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation as recommended by aluminum producer.

3.2 ROOF-EDGE SPECIALTIES INSTALLATION

A. **General.** Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. **Installation.** Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.3 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. **General.** Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. **Gutters.** Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts. Reduce spacing as required by the gutter metal manufacturer to meet performance requirements.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.

C. **Downspouts.** Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.

3.4 CLEANING AND PROTECTION

A. **Clean exposed metal surfaces** in accordance with manufacturer's instructions. Touch-up damaged metal coatings.

B. **Protection.** Provide protective measures as required to ensure that work of this section will be without damage or deterioration at time of substantial completion.

END OF SECTION

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SECTION 07 72 00

ROOF ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the roof accessories in accordance with the plans and as specified herein.

B. This section includes the following:

1. Roof hatches.

2. Roof Curbs

C. **Related Sections.** The following sections contain requirements that relate to this section:

1. Division 6 section "Rough Carpentry" for roof deck and nailers.

2. Division 7 section for roofing types and roofing accessories included as part of roofing work.

3. Division 7 section "Manufactured Roof Specialties" for fascia, coping, gravel stops, and roof expansion joint covers.

4. Division 7 section "Flashing and Sheet Metal" for metal flashing.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the roof accessories in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Standards.** Comply with the following:

1. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

2. National Roof Contractor's Association (NRCA) "Roofing and Waterproofing Manual" details for installation of units.

3. National Fire Protection Association (NFPA) 204M for smoke and heat vent design constraints, operation, and location.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** according to Conditions of Contract and Division 1 specification sections.

1. Product data for each type of product specified. Submit manufacturer's detailed technical product data, installation instructions and recommendations, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

2. Shop drawings showing fabrication and installation of each roof accessory specified including fully dimensioned plans, elevations, sections, details of components, and attachments to other units of work. Also show layout, anchorage details, rough-in requirements, and conditions on the roof or for other accessories.

3. Samples for initial selection purposes in the form of manufacturer's color charts showing full range of colors, textures, shapes, and sizes available for each type of roof accessory indicated.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Roof Hatches.

a. Babcock-Davis Hatchways, Inc.

b. Bilco Co.

c. ThyCurb Div./ThyBar Corp.

B. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Roof Curbs.

a. Babcock-Davis Hatchways, Inc.

b. Bilco Co.

c. ThyCurb Div./ThyBar Corp.

2.2 MATERIALS, GENERAL

A. **Aluminum Sheets.** ASTM B 209 for Alclad alloy 3005H25 or alloy and temper required to suit forming operations with mill finish, unless indicated otherwise.

B. **Extruded Aluminum.** ASTM B 221 alloy 6063-T52 or alloy and temper required to suit structural and finish requirements. Mill finish, unless indicated otherwise.

C. **Insulation.** Manufacturer's standard rigid or semi-rigid glass fiber board of thickness indicated.

D. **Wood Nailers.** Softwood lumber, pressure treated with water borne preservatives for above ground use, complying with AWPA C2; not less than 1-1/2 inches thick.

E. **Fasteners.** Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removal of exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

F. **Gaskets.** Manufacturer's standard tubular or fingered design of neoprene or polyvinyl chloride (PVC), or block design of sponge neoprene.

G. **Elastomeric Sealant.** Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, and, A.

2.3 FINISHES

A. **General.** Comply with NAAMM "Metal Finishes Manual" for recommendations on applying and designating finishes.

B. **Finish designations prefixed by Aluminum Association** (AA) conform to the system for designating aluminum finishes established by the AA.

C. **Class I, Color Anodized Finish.** AA-M12C22A42/A44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, film thicker than 0.7 mil with integral color or electrolytically deposited color) complying with AAMA 606.1 or AAMA 608.1.

1. 1.Color. As selected by Engineer/Architect from within standard industry colors and color density range.

2.4 ROOF HATCHES

A. **General.** Fabricate units to withstand 40 lbf psf external loading and 20 pounds per square foot internal loading pressure. Frame with a minimum 9-inch-high, integral curb, double-wall construction, with a minimum 1-inch insulation, cant strips and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Option to include a built-in, self-drainage feature that eliminates water accumulation on the up-slope side of curb. Provide double wall cover (lid) construction with 1inch insulation core. Provide gasketing and equip corrosion resistant or hot dip galvanized hardware including pintle hinges, hold open devices, exterior padlock hasps, and both interior and exterior latch handles.

B. **Type.** Double leaf for equipment access.

1. Size: As indicated on drawings.

C. Material. Aluminum, sheets and extrusions.

2.5 ROOF CURBS

A. **General.** Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides and integrally formed deck-mounting flange at perimeter bottom.

B. **Type.** Double wall insulated.

1. Size: 18” high unless otherwise noted on drawings.

C. **Material.** Aluminum, sheets and extrusions.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General.** Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, vapor barriers, roof insulation, roofing and flashing, as required, to ensure that each element of the work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses, as well as inward and outward loading pressures.

1. Except as otherwise indicated, install roof accessory items according to construction details of NRCA "Roofing and Waterproofing Manual."

B. **Isolation.** Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

C. **Flange Seals.** Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

D. **Cap Flashing.** Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with roofing or roof flashing (as counterflashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

E. **Operational Units.** Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.2 CLEANING AND PROTECTION

A. **Clean exposed metal and plastic surfaces** according to manufacturer's instructions. Touch up damaged metal coatings.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide all labor, materials, tools, and equipment necessary to furnish and apply joint sealants in accordance with the plans and as specified herein.

B. **Work Included.** This section includes joint sealants for the following locations:

1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:
    a. Control and expansion joints in cast-in-place concrete.
    b. Control and expansion joints in unit masonry.
    c. Joints between different materials listed above.
    d. Perimeter joints between materials listed above and frames of doors and windows.
    e. Control and expansion joints in ceiling and overhead surfaces.
    f. Other joints as indicated.
2. Exterior joints in horizontal traffic surfaces as indicated below:
    a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
    b. Joints between different materials listed above.
    c. Other joints as indicated.
3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints of exterior openings where indicated.
    c. Joints between tops of nonload bearing unit masonry walls and underside of cast-in-place concrete slabs and beams.
    d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
    e. Joints on underside of precast beams and planks.
    f. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

g. Perimeter joints of toilet fixtures.

h. Other joints as indicated.

4. Interior joints in horizontal traffic surfaces as indicated below:

a. Control and expansion joints in cast-in-place concrete slabs.

b. Control and expansion joints in tile flooring.

c. Other joints as indicated.

C. **Related Sections.** The following sections contain requirements that relate to this section:

1. Division 7 section "Flashing and Sheet Metal" for sealing joints related to flashing and sheet metal for roofing.

2. Division 8 "Glass and Glazing" for sealants used in glazing.

1.3 QUALITY ASSURANCE

A. **Codes.** Perform all work in compliance with all federal, state, and local codes.

B. **Standards.** Materials and workmanship shall be in accordance with the following standards:

1. AAMA - American Architectural Manufacturers Association.

2. ASTM - American Society for Testing and Materials.

3. FS - Federal Specifications.

C. **Regulatory Agencies.** Perform all work in compliance with the requirements of the following regulatory agencies:

1. ADA - Americans with Disabilities Act.

2. OSHA - Occupational Safety and Health Administration.

D. **Installer Qualifications.** Engage an experienced installer who has completed joint sealant applications similar in material, design, and extent to that indicated for project that have resulted in construction with a record of successful in service performance.

E. **Testing Laboratory Qualifications.** To qualify for acceptance, an independent testing laboratory must demonstrate to Engineer/Architect's satisfaction, based on evaluation of laboratory submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying progress of the work.

F. **Single-Source Responsibility for Joint Sealant Materials.** Obtain joint sealant materials from a single manufacturer for each different product required.

G. **Preconstruction Compatibility and Adhesion Testing.** Submit to joint sealant manufacturers samples of materials that will contact or affect joint sealants for compatibility and adhesion testing as indicated below:

1. Use test methods standard with manufacturer to determine if priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Submit not less than nine pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.

3. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the work.

4. Investigate materials failing compatibility or adhesion tests and obtain joint sealant manufacturer's written recommendations for corrective measures, including use of specially formulated primers.

5. Testing will not be required when joint sealant manufacturer is able to submit joint preparation data required above that are acceptable to Engineer/Architect and are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

H. **Product Testing.** Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of Contractor's submittal of test results to Engineer/Architect.

1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C 920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), low temperature flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.

2. Include test results performed on joint sealants after they have cured for 1 year.

I. **Preconstruction Field Testing.** Prior to installation of joint sealants, field test their adhesion to joint substrates as follows:

1. Locate test joints where indicated or, if not indicated, as directed by Engineer/Architect.

2. Conduct field tests for each application indicated below:

   a. Each type of elastomeric sealant and joint substrate indicated.

   b. Each type of nonelastomeric sealant and joint substrate indicated.

3. Notify Engineer/Architect 1 week in advance of the dates and times when field test will be performed.

4. Test Method. Test joint sealants by hand pull method described below:

   a. Install joint sealants in 5-foot joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed work. Allow sealants to cure fully before testing.

   b. Make knife cuts horizontally from one side of joint to the other followed by two vertical cuts approximately 2 inches long at side of joint and meeting horizontal cut at top of 2-inch cuts. Place a mark 1 inch from top of 2-inch piece.

c. Use fingers to grasp 2-inch piece of sealant just above 1-inch mark; pull firmly down at a 90-degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

5. Report whether or not sealant in joint connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.

6. Evaluation of Field Test Results. Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 SUBMITTALS

A. **General.** Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data from manufacturers for each joint sealant product required.

a. Certification by joint sealant manufacturer that sealants plus the primers and cleaners required for sealant installation comply with local regulations controlling use of volatile organic compounds (VOC).

2. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

3. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

4. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project names addresses, names of Engineer/Architects and Owners, plus other information specified.

5. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

6. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

7. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

1.5 JOB CONDITIONS

A. **Coordination - Interfacing.** Coordinate with all other trades to prevent delays, errors, and omissions.

B. **Environmental Conditions.** Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 degrees Fahrenheit (^{o} F.) (4.4 degrees Celsius [^{o} C.]).

2. When joint substrates are wet.

C. **Joint Width Conditions.** Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

D. **Joint Substrate Conditions.** Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery.** Deliver materials to project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. **Storage and Handling.** Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 SPECIAL WARRANTY

A. **Special Installer's Warranty:** Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. **Special Manufacturer's Warranty:** Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

C. **Special warranties** specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.8 SYSTEM PERFORMANCE REQUIREMENTS

A. **General**. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. **Interior Applications**. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.9 SEQUENCING AND SCHEDULING

A. **General.** Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

A. **Compatibility.** Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. **Colors.** Provide color of exposed joint sealants to comply with the following:

1. Provide selections made by Engineer/Architect from manufacturer's full range of standard colors for products of type indicated.

2.2 ELASTOMERIC JOINT SEALANTS

A. **Elastomeric Sealant Standard.** Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.

1. Additional Movement Capability. Where additional movement capability is specified in Elastomeric Joint Sealant Data Sheet, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for Uses indicated.

B. **Available Products.** Subject to compliance with requirements, elastomeric sealants that may be incorporated in the work include, but are not limited to, the products specified in the applicable paragraphs below.

2.3 SOLVENT RELEASE CURING JOINT SEALANTS

A. **Acrylic Sealant.** Manufacturer's standard one part, nonsag, solvent release curing acrylic terpolymer sealant complying with AAMA 808.3 or FS TT-S-00230 or both, with capability when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the following percentage change in joint width existing at time of application and remain adhered to joint substrates indicated for project without failing cohesively:

1. 12-1/2 percent movement in both extension and compression for a total of 25 percent.

B. **Butyl Sealant.** Manufacturer's standard one part, nonsag, solvent release curing, polymerized butyl sealant complying with ASTM C 1085 and formulated with minimum of 75 percent solids to be nonstaining, paintable, and have a tack free time of 24 hours or less.

C. **Pigmented Narrow Joint Sealant.** Manufacturer's standard, solvent release curing, pigmented synthetic rubber sealant complying with AAMA 803.3 and formulated for sealing joints 3/16 inch or smaller in width.

D. **Available Products.** Subject to compliance with requirements, solvent release curing joint sealants that may be incorporated in the work include, but are not limited to, the following:

1. Acrylic Sealant.
    a. 60+Unicrylic, Pecora Corp.
    b. PTI 738, Protective Treatments, Inc.
    c. PTI 767, Protective Treatments, Inc.
    d. Mono, Tremco, Inc.

2. Butyl Sealant.
    a. BC-158, Pecora Corp.
    b. PTI 757, Protective Treatments, Inc.
    c. Sonneborn Multipurpose Sealant, Sonneborn Building Products Div., ChemRex, Inc.
    d. Tremco Butyl Sealant, Tremco, Inc.
3. Pigmented Narrow Joint Sealant.
    a. PTI 200, Protective Treatments, Inc.

2.4 LATEX JOINT SEALANTS

A. **General.** Provide manufacturer's standard one part, nonsag, mildew resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.

B. **Acrylic Emulsion Sealant.** Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.

C. **Silicone Emulsion Sealant.** Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.

D. **Available Products.** Subject to compliance with requirements, latex joint sealants that may be incorporated in the work include, but are not limited to, the following:

1. Acrylic Emulsion Sealant.
    a. Bostik Findley; Chem-Calk 600.
    b. Pecora Corporation; AC-20+.
    c. Schnee-Morehead, Inc.; SM 8200.
    d. Sonneborn, Division of ChemRex Inc.; Sonolac.
    e. Tremco; Tremflex 834.
2. Silicone Emulsion Sealant.
    a. "Trade Mate Paintable Glazing Sealant," Dow Corning Corp.

2.5 TAPE SEALANTS

A. **Tape Sealant.** Manufacturer's standard, solvent free, butyl based tape sealant with a solids content of 100 percent formulated to be nonstaining, paintable, and nonmigrating in contact with nonporous surfaces with or without reinforcement thread to prevent stretch and packaged on rolls with a release paper on one side.

B. **Available Products.** Subject to compliance with requirements, tape sealants that may be incorporated in the work include, but are not limited to, the following:

1. Extru-Seal Tape, Pecora Corp.
2. Shim-Seal Tape, Pecora Corp.
3. PTI 606, Protective Treatments, Inc.
4. Tremco 440 Tape, Tremco, Inc.
5. MBT-35, Tremco, Inc.

2.6 PREFORMED FOAM SEALANTS

A. **Preformed Foam Sealants.** Manufacturer's standard preformed, precompressed, impregnated open cell foam sealant manufactured from high density urethane foam impregnated with a nondrying, water repellent agent; factory produced in precompressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to the degree specified by manufacturer; and complying with the following requirements:

1. Properties. Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.
2. Impregnating Agent. Manufacturer's standard.
3. Density. Manufacturer's standard.
4. Backing. None.
5. Backing. Pressure sensitive adhesive factory-applied to one side with protective wrapping.
6. Available Products. Subject to compliance with requirements, preformed foam sealants that may be incorporated in the work include, but are not limited to, the following:
    a. Emseal, Emseal Corp.
    b. Emseal Greyflex, Emseal Corp.

c. Wil-Seal 150, Wil-Seal Construction Foams Div., Illbruck.

d. Wil-Seal 250, Wil-Seal Construction Foams Div., Illbruck.

2.7 JOINT SEALANT BACKING

A. **General.** Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. **Plastic Foam Joint Fillers.** Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Open cell polyurethane foam.

2. Closed cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

3. Proprietary, reticulated, closed cell polymeric foam, nonoutgassing, with a density of 2.5 pcf and tensile strength of 35 pounds per square inch (psi) per ASTM D 1623, and with water absorption less than 0.02 gms/cc per ASTM C 1083.

4. Any material indicated above.

C. **Elastomeric Tubing Joint Fillers.** Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26° F. (-32° C.). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. **Bond Breaker Tape.** Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. **Primer.** Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

B. **Cleaners for Nonporous Surfaces.** Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. **Masking Tape.** Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

A. **General.** Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Surface Cleaning of Joints.** Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.

3. Remove laitance and form release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. **Joint Priming.** Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. **Masking Tape.** Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. **General.** Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. **Sealant Installation Standard.** Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. **Acoustical Sealant Application Standard.** Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. **Installation of Sealant Backings.** Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

    a. Do not leave gaps between ends of joint fillers.

    b. Do not stretch, twist, puncture, or tear joint fillers.

    c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

E. **Installation of Sealants.** Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

F. **Tooling of Nonsag Sealants.** Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

2. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.

    a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.

G. **Installation of Preformed Foam Sealants.** Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

3.4 CLEANING

A. **General.** Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. **General.** Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

3.6 DEMONSTRATION

A. **General.** Prior to final acceptance, the Contractor shall demonstrate to representatives of the Engineer/Architect (and/or Owner) that the in-place joint sealants are equal to the quality and appearance of the accepted mock-ups.

END OF SECTION

SECTION 07 92 01

CAULKING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the caulking in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards referenced herein.

1. ASTM – American Society for Testing and Materials.
2. FS – Federal Specification.
3. NSF – National Sanitation Foundation.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's specifications, including manufacturer's published data indicating that material complies with the specifications and is intended for the applications shown, recommendations and installation instructions for caulking compound and associated miscellaneous material required.

B. **Color Chart**. Submit manufacturer's standard color chart for color selection by the Owner.

1.5 JOB CONDITIONS

A. Environmental Conditions

1. Proceed with installation of caulking under weather conditions when temperatures are within manufacturer's recommended limitations for installation.
2. Proceed with the work only when forecasted weather conditions are favorable for proper care and development of high early bond strength.
3. Wherever joint width is affected by ambient temperature variations, install caulking only when temperatures are in the lower third of the manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
4. Avoid mixing sealants in direct sunlight when high temperatures prevail.

B. Protection

1. Allow no caulking to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces including rough textured materials.

2. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces by either the primer/sealer or caulking materials.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Each unit shall be labeled with the following:

a. Name of material and supplier.

b. Formula or specification number, lot number, color, and date of manufacture.

c. Mixing instructions, shelf life, and curing time when applicable.

B. Storage

1. Store or expose no materials to temperatures above 90 degrees Fahrenheit (° F.) or in direct sunshine.

2. Use no materials which are outdated as indicated by shelf life.

3. Store sealant tape in a manner which will retain shape.

4. Store containers where temperature is approximately 75° F. for 16 hours before using.

C. **Handling**. Open no containers or mix components until necessary preparatory work and priming have been completed.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 CAULKING

A. **Type**. Two component, premium grade, polyurethane base, elastomeric sealant formulated for total immersion with a nonsag and self-leveling consistency.

B. **Color**. As selected by the Owner.

C. Requirements

1. Meet ASTM C920 and FS TT-S-00227E.

2. Type. M.

3. Grade. NS.

4. Class. 25.

5. Use. NT, M, G, A.

6. Elasticity. Minimum 50 percent at 0 degrees Fahrenheit (° F.).

7. NSF "Approved for Contact with Potable Water."

2.2 MISCELLANEOUS

A. **Joint Cleaner**. Provide the type of joint cleaning compound recommended by the caulking manufacturer for all joint surfaces.

B. **Joint Primer/Sealer**. Provide the type of joint primer/sealer recommended by the caulking manufacturer for all joint surfaces.

C. **Bond Breaker Type**. Polyethylene tape or other plastic tape as recommended by the caulking manufacturer to be applied to sealant contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of caulking. Provide self-adhesive tape wherever applicable.

D. **Sealant Backer Rod**. Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with caulking by the manufacturer. Provide size and shape of rod which will control the joint depth.

2.3 PRODUCTS AND MANUFACTURERS

A. **Products**. Provide one of the following:

1. Sikaflex 2cNs, two-component by Sika Chemical Company.

2. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General**. Comply with caulking manufacturer's written instructions except where more stringent requirements are shown or specified.

B. Areas to Be Caulked

1. Interior and exterior perimeter of all door and window frames.

2. Interior and exterior perimeter of all louvers and wall openings.

3. Interior and exterior joints formed by the junction of masonry work, concrete, and precast decking.

4. All ceiling joints of precast concrete slabs.

5. Wall panel, fascia, soffit, and coping joints.

6. All reglets and expansion joints.

7. Where else shown on the drawings and as required by the Engineer/Architect.

C. Surface Preparation

1. Remove dirt, moisture, loose material, and other substances that would interfere with bond.

2. Clean joint surface with oil free pressurized air immediately before installation of primer/sealer.

D. Mixing

1. Two Component. Follow manufacturer's written instructions.

a. Thoroughly mix components before use.

b. Add entire contents of activator and color components to base material. Do not mix partial units.

c. Mix contents for 3 to 5 minutes as recommended by manufacturer and until color and consistency are uniform.

d. Do not use mixture after pot life has expired.

E. **Priming**. Prime all joint surfaces.

1. Allow no primer or sealer to spill or migrate onto adjoining surfaces.

2. Allow primer to dry prior to application of sealants.

F. Isolation Joint

1. Apply masking tape before installation of primer in continuous strips in alignment with the joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.

2. Install no sealants without backer rods or bond breaker tape, unless shown otherwise.

3. Roll the back-up rod stock into the joint to avoid lengthwise stretching. Do not twist, braid, puncture, or prime backer rods.

G. Placement

1. Caulking shall be by gun method. Select gun nozzle to suit conditions and provide a full bead of caulking throughout the joint.

2. Use installation techniques that will ensure caulking to be deposited in a uniform, continuous ribbon without skip marks, pin holes, air pockets, and uniform bond on opposite sides, produced by a complete "wetting" of the joint bond surfaces equally on the opposite sides.

3. Follow with hand tool in finished areas for a uniform neat appearance.

3.2 CLEANING AND PROTECTION

A. **Cleaning**. Clean adjacent surfaces of sealant or soiling resulting from the work.

1. Use solvent or cleaning agent recommended by the caulking manufacturer.

2. Leave all finish work in a neat clean condition.

B. **Curing Time**. Allow the minimum curing time as recommended by the manufacturer, but in no case shall the curing time be less than 72 hours.

C. **Protection**. Protect the caulking during the construction period so that it will be without deterioration, soiling, discoloration, or damage at the time of final acceptance.

END OF SECTION

SECTION 08 06 71

DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1) Mechanical door hardware.
2) Electromechanical and access control door hardware.
3) Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4) Automatic operators.
5) Cylinders specified for doors in other sections.

b. Related Sections:

1) Division 08 Section “Door Hardware”.

c. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1) ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2) ICC/IBC - International Building Code.
3) NFPA 70 - National Electrical Code.
4) NFPA 80 - Fire Doors and Windows.
5) NFPA 101 - Life Safety Code.
6) NFPA 105 - Installation of Smoke Door Assemblies.
7) State Building Codes, Local Amendments.

d. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

a. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

b. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1) Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2) Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3) Content: Include the following information:

a) Type, style, function, size, label, hand, and finish of each door hardware item.

b) Manufacturer of each item.

c) Fastenings and other pertinent information.

d) Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

e) Explanation of abbreviations, symbols, and codes contained in schedule.

f) Mounting locations for door hardware.

g) Door and frame sizes and materials.

4) Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

c. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

d. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

e. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

f. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

a. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

b. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

c. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

a. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 MAINTENANCE SERVICE

a. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

a. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 EXECUTION

3.1 DOOR HARDWARE SETS

a. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1) Quantities listed are for each pair of doors, or for each single door.

2) The supplier is responsible for handing and sizing all products.

3) Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4) At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

5) Refer to the "Door & Frame Schedule" on sheet A-16 in the drawings for scheduling of door hardware sets.

b. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1) Section 08 71 00 – Door Hardware.

c. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. OT - Other
4. RO - Rockwood
5. RU - Corbin Russwin
6. RF - Rixson
7. NO - Norton
8. SU - Securitron

Hardware Sets
(refer to Door Schedule on Sheet A-16 for additional details)

Set: 1.0

2 Continuous Hinge	CFM-SLF-HD1		PE
1 Removable Mullion	910KM		RU
1 Rim Exit Device, Nightlatch	ED5200S K157ET x LC M110 M52 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Exit Device (rim, exit only)	ED5200S EO M110 M52 **SPAR CLEAR POWDER COAT*	626 CPC	RU
3 Mortise Cylinder	- Match Owner's existing key system	626	OT
1 Rim Cylinder	- Match Owner's existing key system	626	OT
2 Pull	RM201 Mtg-Type 12XHD	US32D-316	RO
2 Conc Overhead Stop	6-X36	630	RF
2 Surface Closer	J7500 x mounting plate to suit application	600 x 689	NO
1 Threshold	252x3AFG Pemko MSES25SS		PE
1 Weatherstrip	- integral within construction of door and frame assembly		OT
2 Sweep	29326CNB TKSP		PE
2 Position Switch	DPS-M-BK		SU

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 2.0

1 Continuous Hinge	CFM-SLF-HD1		PE
1 Rim Exit Device, Storeroom	ED5200S N959ET M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Rim Cylinder	- Match Owner's existing key system	626	OT
1 Surface Closer	CPS7500	600 x 689	NO
1 Threshold	252x3AFG Pemko MSES25SS		PE
1 Weatherstrip	- integral within construction of door and frame assembly		OT
1 Sweep	29326CNB TKSP		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 3.0

2 Continuous Hinge	CFM-HD1		PE
1 Removable Mullion	910KM		RU
1 Rim Exit Device, Nightlatch	ED5200S K157ET x LC M110 M52 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Exit Device (rim, exit only)	ED5200S EO M110 M52 **SPAR CLEAR POWDER COAT*	626 CPC	RU
3 Mortise Cylinder	- Match Owner's existing key system	626	OT
1 Rim Cylinder	- Match Owner's existing key system	626	OT
1 Vandal Resistant Trim	VRT22	US32D	RO
1 Vandal Resistant Trim	VRT22 C	US32D	RO
2 Surface Closer	CPS7500	600 x 689	NO
2 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Threshold	252x3AFG Pemko MSES25SS		PE

1 Gasketing	2891APK TKSP8		PE
1 Rain Guard	346C TKSP8		PE
2 Door Bottom	216BDCFG TKSP8		PE
2 Astragal	316APK TKSP8		PE
2 Position Switch	DPS-M-BK		SU

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 4.0

1 Continuous Hinge	CFM-HD1		PE
1 Rim Exit Device, Storeroom	ED5200S N959ET M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Rim Cylinder	- Match Owner's existing key system	626	OT
1 Surface Closer	CPS7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Threshold	252x3AFG Pemko MSES25SS		PE
1 Gasketing	2891APK TKSP8		PE
1 Rain Guard	346C TKSP8		PE
1 Door Bottom	216BDCFG TKSP8		PE
1 Position Switch	DPS-M-BK		SU

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 5.0

6	Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1	Exit Device (surface vertical rod, exit only)	ED5470 M110 M55 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1	Exit Device (surface vertical rod, storeroom)	ED5470 N959 M110 M55 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1	Rim Cylinder	- Match Owner's existing key system	626	OT
2	Surface Closer	PR7500	600 x 689	NO
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO
2	Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 6.0

3	Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1	Fire Rated Rim Exit, Storeroom	ED5200A N959ET M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1	Rim Cylinder	- Match Owner's existing key system	626	OT
1	Surface Closer	PR7500	600 x 689	NO
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO
1	Wall Stop	406 / 409	US32D	RO
1	Gasketing	S88BL		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 7.0

3 Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1 Rim Exit Device, Passage	ED5200 N910ET M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 8.0

3 Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1 Fire Rated Rim Exit, Passage	ED5200A N910ET M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
1 Gasketing	S88BL		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 9.0

2	Continuous Hinge	CFM-HD1		PE
2	Surface Vert Rod Exit, Passage	ED5470 N910ET M55 M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
2	Surface Closer	PR7500	600 x 689	NO
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO
2	Wall Stop	406 / 409	US32D	RO
2	Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 10.0

2	Continuous Hinge	CFM-HD1		PE
2	Fire Rated Surf Vert Rod, Passage	ED5470B N910ET M55 M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
2	Surface Closer	CPS7500	600 x 689	NO
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO
1	Gasketing	S88BL		PE
1	Astragal	S772C		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 11.0

1 Continuous Hinge	CFM-HD1		PE
1 Rim Exit Device, Passage	ED5200 N910ET M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	PR7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
1 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 12.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Storeroom Lock	ML2057 NSA M26 LC **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Wall Stop	406 / 409	US32D	RO
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 13.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Storeroom Lock	ML2057 NSA M26 LC **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 14.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Storeroom Lock	ML2057 NSA M26 LC **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	CPS7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 15.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Storeroom Lock	ML2057 NSA M26 LC **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surf Overhead Stop	10-X36	630	RF
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Gasketing	S88BL		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 16.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Entrance Lock	ML2053 NSA M26 LC **SPAR CLEAR POWDER COAT**	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 17.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Entrance Lock	ML2053 NSA M26 LC **SPAR CLEAR POWDER COAT**	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
1 Gasketing	S88BL		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 18.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Passage Latch	ML2010 NSA M26 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Conc Overhead Stop	1-X36	630	RF
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 19.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Passage Latch	ML2010 NSA M26 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 20.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Passage Latch	ML2010 NSA M26 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	PR7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
3 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 21.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Passage Latch	ML2010 NSA M26 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
1 Gasketing	S88BL		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 22.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Privacy Lock	ML2060 NSA M34 M26 V21 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
3 Silencer	608 / 609		RO
1 Coat Hook	796	US26D	RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 23.0

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Privacy Lock	ML2060 NSA M34 M26 V21 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surf Overhead Stop	10-X36	630	RF
1 Surface Closer	R 7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
3 Silencer	608 / 609		RO
1 Coat Hook	796	US26D	RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 24.0

2 Continuous Hinge	CFM-HD1		PE
1 Flush Bolt	2845 / 2945	US32D	RO
1 Dust Proof Strike	570	US26D	RO
1 Entrance Lock	ML2053 NSA M26 LC **SPAR CLEAR POWDER COAT**	626 CPC	RU
1 Surface Closer	PR7500	600 x 689	NO
2 Kick Plate	K1050 10" high CSK BEV	US32D	RO
2 Wall Stop	406 / 409	US32D	RO
2 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 25.0

1 Continuous Hinge	CFM-HD1		PE
1 Passage Latch	ML2010 NSA M26 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	PR7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	406 / 409	US32D	RO
1 Silencer	608 / 609		RO

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 26.0

1 Continuous Hinge	- Reuse existing	630	OT
1 Storeroom Lock	ML2057 NSA M26 LC **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Surface Closer	CPS7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Gasketing	S88BL		PE

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 27.0

2 Continuous Hinge	- Reuse existing	630	OT
1 Removable Mullion	910KM		RU
1 Rim Exit Device, Nightlatch	ED5200S K157ET x LC M110 M52 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Exit Device (rim, exit only)	ED5200S EO M110 M52 **SPAR CLEAR POWDER COAT*	626 CPC	RU
3 Mortise Cylinder	- Match Owner's existing key system	626	OT
1 Rim Cylinder	- Match Owner's existing key system	626	OT
1 Vandal Resistant Trim	VRT22	US32D	RO
1 Vandal Resistant Trim	VRT22 C	US32D	RO
2 Surface Closer	CPS7500	600 x 689	NO
2 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Threshold	252x3AFG Pemko MSES25SS		PE
1 Gasketing	2891APK TKSP8		PE
1 Rain Guard	346C TKSP8		PE
2 Door Bottom	216BDCFG TKSP8		PE
2 Astragal	316APK TKSP8		PE
2 Position Switch	DPS-M-BK		SU

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 28.0

1 Continuous Hinge	- Reuse existing	630	OT
1 Entrance Lock	ML2053 NSA M26 LC **SPAR CLEAR POWDER COAT**	626 CPC	RU
1 Rim Exit Device, Storeroom	ED5200S N959ET M110 **SPAR CLEAR POWDER COAT*	626 CPC	RU
1 Rim Cylinder	- Match Owner's existing key system	626	OT
1 Surface Closer	CPS7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Threshold	252x3AFG Pemko MSES25SS		PE
1 Gasketing	2891APK TKSP8		PE
1 Rain Guard	346C TKSP8		PE
1 Door Bottom	216BDCFG TKSP8		PE
1 Position Switch	DPS-M-BK		SU

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 29.0

1 Continuous Hinge	- Reuse existing	630	OT
1 Entrance Lock	ML2053 NSA M26 LC **SPAR CLEAR POWDER COAT**	626 CPC	RU
1 Surface Closer	CPS7500	600 x 689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Threshold	252x3AFG Pemko MSES25SS		PE
1 Gasketing	2891APK TKSP8		PE
1 Rain Guard	346C TKSP8		PE
1 Door Bottom	216BDCFG TKSP8		PE
1 Position Switch	DPS-M-BK		SU

Notes:

*****FIELD VERIFY SPECIFIED HARDWARE WILL WORK WITH EXISITNG CONDITIONS. IF SPECIFIED HARDWARE WILL NOT WORK WITH EXISTING CONDITIONS MODIFY HARDWARE SETS AS REQUIRED*****

Set: 30.0

1 Hardware	- Provided by Overhead Door Contractor	OT

END OF SECTION

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
5. Division 08 Section "Door Hardware".
6. Division 08 Section "Access Control Hardware".
7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

    a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Steelcraft (S).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by

referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. CECO Door Products (C) Honeycomb Core - Regent Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:

    a. CECO Door Products (C) - BU Series.
    b. CECO Door Products (C) - SU Series.

C. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LOUVERS

A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.7 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Two anchors per jamb up to 60 inches high.
2) Three anchors per jamb from 60 to 90 inches high.
3) Four anchors per jamb from 90 to 120 inches high.
4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION

SECTION 08 12 00

DOORS AND FRAMES, ALUMINUM FULL FLUSH

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide all labor, tools, equipment, and materials necessary to furnish and install the aluminum full flush doors and frames in accordance with the drawings and as specified herein.

B. Related Sections.

1. Section 08 71 00 Door Hardware for door hardware to be installed on aluminum doors.

2. Section 08 80 00 Glazing for glass to be installed in aluminum doors and transoms.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies.** Perform all work in compliance with all applicable federal, state, and local codes and regulatory agencies.

B. **Standards.** All materials and workmanship shall be in compliance with the following standards.

1. AA - Aluminum Association.

2. FS - Federal Specifications.

C. **Qualifications**. Aluminum doors, frames, and accessories shall be manufactured by a single firm specializing in the production of this type of work.

1.4 SUBMITTALS

A. **General.** Comply with Section 01 33 00, “Submittals” and submit the following supplemental requirements within this specification section.

B. **Product Data.** Submit door manufacturer's technical data for each type of door and frame with accessories.

C. **Shop Drawings.** Submit drawings showing:

1. Details of doors and frames.

2. Elevation of door types.

3. Conditions of openings.

4. Details of construction of door and frames.

5. Finishes.

6. Location and installation requirements of finish hardware and reinforcement.

7. Hardware schedule for doors.

8. Door schedule utilizing same reference numbers for details and openings as those on the drawings.

9. Method of anchoring.

1.5 JOB CONDITIONS

A. **Protection**. Protect surfaces of doors and frames from stains, marks, or damage during erection and installation.

B. **Coordination.** Coordinate all work with other trades, verify openings and supports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery.** Deliver all doors and frames in protective covers clearly noted as to size, mark number, frame, and hardware group.

B. **Storage**. Store doors, frames, and accessories off the ground, covered and protected from the elements, and allow for the movement of air to prevent condensation.

C. **Handling**. Keep all doors, frames, and accessories in original packages until ready to install or hang.

1.7 SPECIAL WARRANTY

A. **Manufacturer**. Five-year warranty against defects in workmanship and materials, including warping, rotting, decaying, or bowing.

B. **Installer**. Warrant installation procedures and performance for five years against defects due to workmanship and materials handling.

PART 2 PRODUCTS

2.1 MATERIALS

A. Doors

1. Type. Industrial aluminum, full flush type with a vertical, ribbed pattern.

2. Size. 1-3/4 inches thick of the size shown on the drawings.

3. Construction.

a. Sections. All sections shall be extruded Type 6063-T5 aluminum alloy with a thickness of not less than 0.125 inch for door stiles, and 0.50 inch for glazing moldings.

b. Surface Sheet. Face sheets shall be 0.062 inch 5005 alloy aluminum with a vertical, ribbed pattern and bonded to a 1/8 inch thick tempered hardboard.

c. Reinforcing. All cutouts, recesses, mortising, or milling operations required for hardware shall be accurately made and internally reinforced with backing plates to ensure adequate strength of the connection. All reinforcing shall be an integral part of the door.

d. Insulation. Voids within the door shall be filled with a rigid compressed high density mineral insulation complying with FS

HH-1-00529 or a foamed in place polyurethane at a 3-pound-per-cubic-foot density. R 4.75 minimum. Insulation shall fill all tubular framing.

e. Glass Stops and Seals. Glass stops and seals shall be tamperproof screwed on extruded aluminum strips with premolded rubber seals.

4. Clearance. Doors shall clear the finished floor by not more than 1/4 inch or thresholds by not more than 1/8 inch.

5. Glazing.

a. Glass: 1/4 inch tempered.

b. Glass: 1 inch insulating, tempered.

c. Glass Stops and Seals. Glass stops and seals shall be tamperproof Snap-in, 6063-T5 extruded aluminum alloy 0.050 inch thickness strips with premolded vinyl seals.

B. Frames

1. Size and Type. Frames shall be of the size and type shown and shall be not less than 0.125-inch-thick extruded Type 6063-T5 aluminum complete with 1/2 inch x 2 inch stops.

2. Reinforcing. Frames shall be internally reinforced for all hardware as required. All reinforcing shall be an integral part of the frame.

3. Anchors. Provide jamb anchors of suitable design. A minimum of three anchors per jamb shall be provided up to 7'-4", four anchors up to 8 feet, and one additional anchor per jamb for each additional 2 feet above 8 feet.

C. **Replaceable Weather Stripping**. AAMA 701, woolpile with nylon fabric, polypropylene backing at head and jambs.

2.2 FINISH

A. Doors and frames shall be finished as noted on the plans. If no finish is noted, doors and frames shall have an anodized finish in accordance with AAMA standards. Class I, minimum thickness 0.7 mil. Color to be selected by the Owner, from manufacturer's full range of standard colors.

2.3 MANUFACTURER

A. **Product and Manufacturer**. All aluminum flush doors and frames shall be by one manufacturer. Subject to compliance with requirements, manufacturer offering doors and frames which may be incorporated in the work include the following:

1. Cline Aluminum Doors Inc. Series 100BE 5-ply bevel edge heavy duty with optional finish.

2. Special-Lite, Inc.

3. Kawneer.

4. Or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Verify that all openings are properly sized and correctly located.
2. Verify that all jambs and doors are properly sized, drilled, punched, and reinforced correctly for specified hardware, anchors, glass, and glazing.

B. **Verification**. The Contractor shall verify dimensions and quantities required and are responsible for same.

3.2 PREPARATION

A. **Protection**. All units shall be field protected from damage and staining during construction. Units not factory taped or protected shall be protected with a strippable coating of detergent, shaving soap, or petroleum jelly which will be removed prior to caulking.

B. **Isolation.** Isolate all aluminum from contact with masonry, concrete, or other foreign material with a coat of epoxy paint. Paint not to be visible after erection of door and frame.

3.3 INSTALLATION

A. Setting Frames

1. Set frames accurately in position, plumbed, aligned, and securely braced until permanent anchors are set.
2. Remove temporary braces and spreader bars only after frames have been properly set and secured and wall construction is complete.
3. Set stops to conceal all wall anchors.

B. **Setting Doors.** Hang door in preset frames with all hardware, ready for operation.

3.4 REPAIR/RESTORATION

A. Damaged Work

1. Remove from the job site frames that are bowed, twisted, or otherwise unacceptable.
2. All doors and frames that are scratched, dented, stained, marred, or defaced that cannot be restored to original condition or to the satisfaction of the Owner and Engineer/Architect, shall be removed from the job site and replaced at no additional cost to the Owner.

3.5 ADJUSTMENT

A. Final Adjustments

1. Check and readjust operating finish hardware items in work just prior to final inspection.
2. Leave work in complete and proper operating conditions.

3.6 CLEANING

A. At the completion of the project, all doors shall be cleaned as recommended by the manufacturer. The Contractor shall remove all field applied protection and be responsible for any damage resulting from other cleaning methods. No abrasive cleaning agents shall be used.

3.7 DEMONSTRATION

A. **Visual.** The Contractor shall demonstrate to the Owner and Engineer/ Architect that all doors operate freely, uniformly, and quietly without binding, twisting, or sagging. Verify that all frames are solidly anchored. Verify that all hardware is functioning properly.

END OF SECTION

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SECTION 08 12 50

FIBERGLASS-REINFORCED PLASTIC (FRP) DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General Conditions, Special Conditions, Division 1 – "General Requirements," and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install fiberglass-reinforced plastic (FRP) doors in accordance with the plans and as specified herein.

B. **This section includes** the following products.

1. Doors. Seamless, FRP doors.

2. Frames. Seamless, FRP door frames.

3. Provide factory-finished doors and frames (gray).

C. **Door hardware is specified** in another Division 8 specification.

D. **Glass and glazing are specified** in another Division 8 specification.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install FRP doors in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1.4 SUBMITTALS

A. **General.** Comply with Section 01300, "Contractor Submittals" and submit the following supplemental requirements within this specification section.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for each type of door specified, including details of construction, materials, dimensions, hardware preparation, core, profiles, and finishes.

2. Shop drawings showing fabrication and installation of doors. Include elevations of door design types, conditions at openings, details of construction, location and installation requirements of door hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

a. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.

b. Coordinate door hardware preparation with door hardware requirements.

3. Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors available for factory-finished doors.

4. Samples for verification purposes of each type of exposed finish required, prepared on samples not less than 3" x 5" and of same thickness and material indicated for final unit of work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

1.5 JOB CONDITIONS (Not Used)

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. Handle, store, and protect items removed and stored or reset in accordance with Section 01610 and 01611 and the manufacturer's instructions, and the supplemental requirements within this specification section.

B. **Delivery doors and frames** cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

C. **Inspect doors and frames** upon delivery for damage. Minor damage may be repaired provided refinished items are equal in all respects to new work and acceptable to Engineer/Architect; otherwise, remove and replace damaged items as directed.

D. **Store doors and drames** at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid use of nonvented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Manufacturer**. Subject to compliance with requirements, provide FRP doors and frames by one of the following:

1. FRP Doors and Frames.

a. Chem-Pruf Door Co.

b. Corrim Door Systems Division, Fenestra Corporation Fiberglass Technologies, Inc.

c. Marshall Vega Corp.

d. Approved Equal

2.2 MATERIALS

A. **Glass Fiber Reinforcement**. Continuous-strand mats utilizing continuous-strand roving and woven roving.

B. **Resin**. Cross-linking polymer, flame-retardant isophthalic polyester with ultraviolet (UV) inhibitor additives. Class I flame retardant by American Society for Testing and Materials (ASTM) E 84.

C. Supports, Reinforcements, and Anchors. Manufacturer's standard units.

D. **Inserts, Bolts, and Fasteners**. Manufacturer's standard units.

E. **Factory-Applied Finish**. Manufacturer's standard corrosion-resistant finish.

F. **FRP Doors.** Doors shall be made of fiberglass reinforced plastic (FRP) using Class 1 premium resin with no fillers that is specifically tailored to resist chemicals and contaminants typically found in environment for which these specifications are written. Doors shall be 1 ¾ inch thick and of flush construction, having no seams or cracks. For consistency in the resin chemistry tailored for this application and to maintain the same physical properties throughout the structure, all fiberglass components including face plates, stiles and rails and frames must be fabricated by the same manufacturer. Components obtained through various outside sources for plant assembly will not be accepted.

G. **Door Plates** shall be 0.125 inch thick minimum, molded in one continuous piece, starting with 25 mil gelcoat of the color specified, integrally molded with multiple layers of 1.5 ounces per square foot fiberglass mat and one layer of 18 ounce per square yard fiberglass woven roving. Each layer shall be individually laminated with resin as mentioned above. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass to resin. Plate alone to withstand Large Missile Impact per FBC TAS 201. Face plates manufactured using the pultrusion process does not allow for a smooth molded gelcoat finish, the use of woven roving for adequate plate thickness, strength and weight, or the appropriate glass to resin ratio and will not meet the quality standards of this project.

H. **Stiles and Rails** shall be constructed starting from the outside toward the inside, with a matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door. In this manner there will be no miter joints and disparate materials used to form the one-piece stile and rail.

I. **Core material** shall be Polypropylene plastic honeycomb core with a non woven polyester veil for unparalleled plate bonding, 180 PSI typical compression range unless otherwise requested.

J. **Internal Reinforcement** shall be #2 SPF of sufficient amount to adequately support required hardware and function of same.

K. **Finish** of door frame shall be identical with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture resulting in a smooth gloss surface that is dense and non-porous. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120F to 170F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat results in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

2.3 FABRICATION

A. **Fabricate door and frame units** to be rigid, neat in appearance, and free from defects, warp, or buckle. Fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment to ensure proper assembly at project site.

1. Internal Construction. Manufacturer's standard core on inside of face sheets.

2. Clearances. Not more than 1/8 inch at jambs and heads. Not more than 3/4 inch at bottom.

B. **Fabricate exposed faces** of doors and panels, including stiles and rails of nonflush units, from FRP.

C. **Fabricate concealed stiffeners**, reinforcement, edge channels, and moldings from FRP.

D. **Fabricate top and bottom edges** of doors as integral part of door construction.

E. **Exposed Fasteners**. Unless otherwise indicated, provide oval heads for exposed screws and bolts.

F. **Hardware Preparation**. Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of American National Standards Institute (ANSI) A115 Series Specifications for door preparation for hardware.

G. **Reinforce door and frames** to receive surface-applied hardware.

H. **Locate hardware as indicated** on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General**. Install FRP doors and frames and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

B. **Door Installation**. Fit FRP doors accurately in frames.

3.2 ADJUST AND CLEAN

A. **Protection Removal**. Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

B. **Final Adjustments**. Check and readjust operating hardware items, leaving doors undamaged and in complete and proper operating condition.

END OF SECTION

SECTION 08 14 00

WOOD DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install solid core flush wood doors in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with applicable federal, state, and local codes and regulatory agencies.

B. **Standards**. Comply with the following standards:

1. NWWDA – National Wood Window and Door Association.
2. ANSI – American National Standards Institute.
3. AWI – Architectural Woodwork Institute Quality Standard.

C. **Qualifications**. Obtain all wood doors from a single manufacturer specializing in the production of this type of work.

1.4 SUBMITTALS

A. **Product Data**. Submit door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory finishing specifications.

B. **Shop Drawings**. Submit shop drawings showing:

1. Location and size of each door utilizing same reference numbers as those on the drawings.
2. Elevation of each kind of door.
3. Details of construction.
4. Conditions of opening.
5. Method of anchoring.
6. Location and extent of hardware blocking.
7. Fire ratings.
8. Requirements for factory finishing.
9. Indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.
10. Other pertinent data.

C. **Samples**. Submit samples, 1'-0" square for the following:

1. Doors for Transparent Finish. Door faces with solid wood edging representing typical range of color and grain for each species of veneer and solid lumber required.

D. **Special Warranty**. Submit manufacturer's special warranty in accordance with paragraph 1.7 of this section.

1.5 JOB CONDITIONS

A. **Environmental Conditions**. Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location:

1. Referenced AWI quality standard including Section 100-S-3, "Moisture Content."

1.6 ELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Protect doors during transit to prevent damage, soiling, and deterioration. Clearly mark the size, mark number, finish, and hardware group for each door.

B. **Storage**. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors," as well as with manufacturer's instructions. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames, and hardware, using temporary, removable or concealed markings.

C. **Handling**. Keep doors in original packages until ready to hang. Handle per manufacturer's instructions.

1.7 SPECIAL WARRANTY

A. **General**. Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. **Door Manufacturer's Warranty**. Submit with shop drawing, written agreement in door manufacturer's standard form signed by manufacturer, installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.

1. Interior Doors. Lifetime.

PART 2 PRODUCTS

2.1 MATERIALS

A. Doors

1. Type. Full flush solid core with wood veneer on both faces and all edges.

2. Size. 1-3/4 inches thick of the sizes shown on the drawings except closet doors which shall be 1-3/8 inches thick.

3. Core. Particleboard with minimum 30 pound density and conforming to ANSI A208 1LD2.

4. Top and Bottom Rails. Not less than 1-1/8 inches of kiln dried hardwood.

5. Stiles. Not less than 2-5/8 inches of kiln dried hardwood.

6. Cross Band. 1/16-inch-thick hardwood veneer, each face.

7. Adhesive. Type 11 water-resistant for core assembly and Type 1 water-resistant for face assembly.

8. Face. Hardwood veneer of select white maple, plain sliced, rotary cut and book match.

9. Finish. Factory-finished, sealed, and finished to medium rubbed satin.

2.2 FABRICATION

A. Prefitting

1. Factory-prefit and premachine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:

a. Comply with tolerance requirements of AWI for prefitting. Comply with final hardware schedules and door frame shop drawings with hardware templates.

b. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory premachining.

c. Provide 1/8-inch clearance at jambs and head; 1/16 inch at meeting stiles for pairs of doors; 1/8 inch at bottom of door to top of threshold, and 1/4 inch at bottom of door to top of decorative floor finish or covering.

B. Openings

1. Glass. Trim openings with molding to match door finish.

C. **Hardware**. Machine and reinforce doors for all required hardware from templates and physical samples.

D. **Veneer**. Wood veneer shall be applied to both faces and stile edges.

E. **Finish**. All wood doors shall be factory-finished.

1. Finish. AWI System No. 5 catalyzed polyurethane.

2. Staining. Match approved sample for color.

3. Effect. Filled finish.

4. Sheen. Satin medium rubbed effect.

2.3 MANUFACTURERS

A. **Manufacturers**. Subject to compliance with requirements, manufacturers offering doors which may be incorporated in the work include the following:

1. Weyerhauser Company.

2. Eggers Industries.

3. Graham Manufacturing Company.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Verify that all openings are properly sized and correctly located.
2. Verify that all frames are correct, set, and properly anchored.
3. Verify that all jambs and doors are properly sized, drilled, punched, and reinforced correctly for specified hardware, anchors, glass and glazing, and other openings as called for.

B. **Verification**. Verify dimensions and quantities required and be responsible for same.

3.2 PREPARATION

A. **Protection**. Protect all units from damage and staining during construction. Protect all adjacent surfaces and floors from marring, staining, scratches, or damage of any kind.

3.3 INSTALLATION

A. **Hardware**. Mount all hardware as required by specifications for each door.

B. **Setting Doors**. Install wood doors to comply with manufacturer's instructions, AWI standards, and as indicated. Do not hang doors until finish work is complete and area is free of construction traffic that could damage door.

3.4 REPAIR/RESTORATION

A. **Damaged Work**. Remove from the job site all doors that are scratched, dented, stained, marred, or defaced that cannot be restored to original condition or to the satisfaction of the Owner and Engineer/Architect and replace them at no additional cost to the Owner.

3.5 **ADJUSTING**. Make final adjustments to all operating hardware for proper operation.

3.6 **CLEANING**. At the completion of the project, remove all protective covering and clean doors as recommended by the manufacturer.

3.7 DEMONSTRATION

A. **Visual**. Demonstrate that all doors operate freely, uniformly, and quietly without binding, twisting, or sagging. Verify that all frames are solidly anchored. Verify that all hardware is functioning properly.

END OF SECTION

SECTION 08 31 01

FLOOR DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Provide the labor, tools, equipment, and materials necessary to furnish and install floor doors in accordance with the plans and the specifications.

B. Interior floor doors that are flush mounted to concrete floors used to provide access to clearwells shall be covered by ½-inch thick white polypropylene sheet that extends a minimum of 3-inches beyond outside edge of gate frame, and shall be fastened to floor with ¼-inch Stainless Steel Type 316 expansion anchors at 12-inches on-center. Seal edge of plate with continuous silicon bead along edge to minimize gas leakage of chlorine fumes from entering building.

1.3 QUALITY ASSURANCE

A. **Single-Source Responsibility**. Obtain floor doors for entire project from a single manufacturer.

B. **Size Variations**. Obtain Engineer/Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

C. **Coordination**. Furnish inserts and anchoring devices that must be built into other work for installation of floor doors. Coordinate delivery with other work to avoid delay.

1.4 SUBMITTALS

A. Submit the following packages in accordance with Division 1.

B. Submittal Package No. 1 – Product Data

1. Manufacturer’s product data, test reports, and material certifications as required.

2. Product data in form of manufacturer's technical data and installation instructions for each type of floor door assembly, including setting drawings, templates, instructions, and directions for installation of anchorage, devices.

3. Complete schedule, including types, general locations, sizes, floor construction details, finishes, latching or locking provisions, and other data pertinent to installation.

1.5 JOB CONDITIONS

A. Obtain specific locations and sizes for required floor doors from trades requiring floor to concealed equipment, and indicate on submittal schedule.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject with compliance with these specifications, floor doors shall be manufactured by:

1. Bilco.
2. Halliday.
3. U.S.F. Fabrication
4. Or equal.

2.2 MATERIALS AND FABRICATION

A. All Floor Doors.

1. Furnish each assembly manufactured as an integral unit, complete with all parts, and ready for installation.
2. Locks.
   a. Where shown or scheduled, provide one-cylinder lock per door.
   b. Furnish two keys per lock.
   c. Key all locks alike unless otherwise noted.
3. Where shown or scheduled, provide secondary safety grating or netting under the floor door rated for 300 psf live loads.
4. Where shown or scheduled, provide a gastight floor door.
5. Factory finish shall be mill finish. Bituminous coating shall be applied by the manufacturer to the exterior of the frame and all aluminum in contact with concrete or mortar.
6. Leaf shall be 1/4-inch aluminum diamond plate reinforced with aluminum stiffeners as required to prevent distortion of the leaf when in any position.
7. Able to withstand a live load of 300 pounds per square foot (lbs/sf).
8. Arrangement shall be either single leaf or double leaf hinged as shown.
9. Open to 90 degrees and lock automatically in that position.
10. Frames shall be 1/4-inch extruded aluminum.

B. Interior Floor Doors

1. Provide frames with strap anchors bolted to the exterior.
2. Cast steel hinges shall be bolted to the underside and pivot on torsion bars that counterbalance the door for easy operation.
3. Provide a vinyl grip handle to release the hold-open arm and close the cover with one hand. Handle shall be permanently attached, and when not in use, the handle shall set flush with the surface.

C. Exterior Doors

1. Provide channel frames with an anchor flange around the perimeter.
2. Equip doors with heavy forged brass hinges, stainless steel pins, spring operators for easy operation.
3. Provide a vinyl grip handle to release the hold open arm and close the cover with one hand.
4. Provide a snap lock with removable handle.
5. Provide a 1-1/2-inch drainage coupling in the door frame.
6. Pipe drainage to outlet with 1-1/2-inch polyvinyl chloride (PVC) pipe to drain.
7. Hardware shall be stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions for installation of floor doors.

B. **Doors shall be modified** by the manufacturer as required when necessary to suit the installation shown.

C. **Coordinate installation** with work of other trades.

D. **Set frames accurately in position** and securely attach to supports with face plate flush and level in relation to adjacent finish surfaces.

E. **Install doors** to open in the direction shown.

F. Touch up the bituminous coating if damaged.

3.2 ATTACHMENTS

A. Floor Door Schedule.

1. Not Used.

END OF SECTION

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SECTION 08 33 23

DOORS, OVERHEAD COILING-ALUMINUM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install overhead coiling doors, track assemblies, operators, and accessories in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Source Quality Control**. Provide overhead coiling doors as complete units produced by a single manufacturer specializing in the production of this type of work, including hardware, accessories, mounting, and installation components.

B. **Codes and Regulatory Agencies**. Perform all work in compliance with applicable federal, state, and local codes and regulatory agencies.

C. **Standards.** All material and workmanship shall be in conformance with the following standards referenced herein.

1. AA - Aluminum Association.
2. ASTM - American Society for Testing and Materials.
3. NEMA - National Electrical Manufacturers Association.
4. NFPA - National Fire Protection Association.
5. UL - Underwriters' Laboratories, Inc.

D. **Design Criteria**. Design and reinforce coiling doors to withstand 30 pounds per square foot (psf) design wind load and be capable to operate under wind loading pressure of 10 psf for doors 144 square feet (sf) or less and 7 psf for doors over 144 sf.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of overhead coiling door. Provide operating instructions and maintenance information, and complete information describing fire release system including electrical rough-in instructions.

B. **Shop Drawings**. Submit shop drawings for special components and installations which are not fully dimensioned or detailed on manufacturer's data sheets. Provide setting drawings, templates, and directions for installation of anchorage devices.

C. **Operation and Maintenance Manual**. Submit overhead coiling door operation and maintenance (O&M) manual which contains O&M data on each type of door furnished.

1.5 JOB CONDITIONS

A. **Coordination.** Coordinate all work with other trades. Verify openings and supports.

B. **Stain Protection.** Protect surface of doors from stains, marks, or damage during construction.

C. **Inserts and Anchorages**. Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of units.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver all doors and frames in protective covers clearly noted as to mark number and location. Coordinate delivery with other work to avoid delays.

B. **Storage**. All doors, frames, and accessories shall be stored off the ground, covered and protected from the elements, and allow for the movement of air to prevent condensation.

C. **Handling**. Keep all doors, frames, and accessories in original packages until ready to install or hang.

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 MATERIALS

A. **Door Curtain.** Fabricate overhead coiling door curtain of interlocking slats designed to withstand required wind loading, of continuous length for width of door without splices. Unless otherwise indicated, provide reinforcing of slats, slats as recommended by door manufacturer for size and type of door to meet required wind loads.

1. Face Slat. Provide 16-gauge minimum aluminum flat slat.

2. Insulation. Minimum 3/4-inch-thick solid expanded polyurethane between face and back slats with a minimum R value of 4.75.

3. Back Slat. Self-locking minimum 22 gauge Brown and Sharpe aluminum flat slat completely encasing the insulation.

4. Finish. All slats, unless noted otherwise, shall be finished with a dark bronze anodizing in accordance with AA-M12A41C22.

5. Endlocks. Provide locks for curtain alignment and resistance against lateral movement.

6. Windlocks. Provide high strength nylon or malleable iron secured to curtain slats with aluminum rivets. Provide windlocks on every slat on both edges of curtain.

7. Bottom Bar. Provide integral aluminum bottom bar, finished to match slats.

B. Curtain Jamb Guides

1. Fabrication. Fabricate curtain jamb guides of steel angles or channels and angles with sufficient depth and strength to retain curtain loading. Build up units with minimum 3/16-inch thick steel sections, galvanized after fabrication. Slot bolt holes for track adjustment.

2. Anchorage. Secure continuous wall angle to wall framing by 3/8 inch minimum bolts at not more than 30 inches on center (o.c.), unless closer spacing recommended by door manufacturer. Extend wall angles above door opening head to support coil brackets, unless otherwise indicated. Place anchor bolts on exterior wall guides so they are concealed when door is in closed position. Provide removable stops on guides to prevent over travel of curtain, and continuous bar for holding windlocks.

C. Weather Seals

1. Weather Seals. Provide vinyl or neoprene weather stripping for exterior exposed doors, except where otherwise indicated. At door heads, use 1/8-inch-thick continuous sheet secured to inside of curtain coil hood. At door jambs, use 1/8-inch-thick continuous strip secured to exterior side of jamb guide.

D. Counterbalancing Mechanism

1. Torsion Spring. Counterbalance doors by means of adjustable steel helical torsion spring, mounted around a steel shaft and mounted in a spring barrel and connected to door curtain with required barrel rings. Use grease sealed bearings or self-lubricating graphite bearings for rotating members.

2. Counterbalance Barrel. Fabricate spring barrel of hot formed structural quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support roll up of curtain without distortion of slats and limit barrel deflection to not more than 0.03 inch per foot of span and under full load.

a. Provide spring balance of one or more oil tempered, heat treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.

b. Fabricate torsion rod for counterbalancing shaft of case hardened steel, of required size to hold fixed spring ends and carry torsional load.

3. Brackets. Provide mounting brackets of manufacturer's standard design, either cast iron or cold rolled steel plate with bell mouth guide groove for curtain.

4. Hood. Form to entirely enclose coiled curtain and operating mechanism at opening head, and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface mounted hoods, and any portion of between jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

a. Fabricate aluminum hoods for aluminum doors of Alloy 3003 aluminum sheet not less than 0.032-inch-thick, clear anodized finish in accordance with AA-M12A41C22

2.2 ELECTRICAL DOOR OPERATORS

A. **Operator**. Motor operator shall be a 480-volt, 3-phase, 60-hertz high starting torque hoist type, bracket mounted, capable of operating the door at an approximate speed of 1 foot per second (fps). Unit shall be controlled by either NEMA 4X or 7 (XP), as shown on plans, operated momentary contact, three button, push-button station marked "Open," "Close," and "Stop," and an automatic screw type limit switch to break the circuit at termination of travel. High efficiency worm gearing, running in an oil bath shall be furnished, together with a spring set, solenoid operating brake completely housed against dust and moisture, and a magnetic reversing starter in NEMA Type 4X or 7 enclosure, as shown on plans. An emergency hand chain operator which does not affect the timing of the limit switch shall be provided to operate the door in case of power failure or removal of motor for inspection or servicing. Operator shall be designed to transmit motion to the door without shock and automatically release motor from driving unit prior to stalling so as to prevent any damage to unit from any type of overload. An efficient overload protective device, which shall be both heat and current sensing, shall be installed integral with the unit which will break the control circuit and eliminate any possible damage to motor windings. A terminal strip shall be provided in the limit switch for easy field connection of all control wiring.

B. **Safety Device**. Provide compressible, sealed, rubber air tube inside of bottom weather astragal extending full width of door. This air tube shall be connected to an air switch through a self-coiling type air hose. The air switch shall be adjustable for maximum sensitivity. Upon contact of the air tube with any obstruction, the air switch shall reverse the downward travel and return the door curtain to its full open position, without damage to the door or its supporting structure, including the prevention of support structure movement while reversing.

2.3 MANUFACTURERS

A. **Manufacturer.** Subject to compliance with requirements, provide products of one of the following:

1. Atlas Door Corp.
2. The Cookson Co.
3. Kinnear Div., Harsco Corp.
4. North American Rolling Door, Inc.
5. Overhead Door Corp.

2.4 CHAIN OPERATOR

A. **Chain-Hoist Operator**: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Verify all dimensions and quantities at the building and be responsible for same.

2. Verify that all jambs are properly sized and drilled for specific hardware, anchors, tracks, and supports required by door installation.

3.2 INSTALLATION

A. **General.** Install door and operating equipment complete with necessary hardware, jamb, and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturer's instructions, and as specified herein.

3.3 REPAIR/RESTORATION

A. Damaged Work

1. All doors and frames that are scratched, dented, stained, marred, or defaced that cannot be restored to original condition or to the satisfaction of the Owner and Engineer/Architect, shall be removed from the job site and replaced at no additional cost to the Owner.

3.4 ADJUSTMENT

A. **Testing and Adjusting.** Upon completion of installation including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

3.5 CLEANING

A. At the completion of the project, all doors shall be cleaned as recommended by the manufacturer. The Contractor shall remove all field applied protection and be responsible for any damage resulting from other cleaning methods. No abrasive cleaning agents shall be used.

3.6 DEMONSTRATION

A. **Visual.** The Contractor shall demonstrate to the Owner and/or Engineer/Architect that all doors operate freely, uniformly, and quietly without binding, twisting, or sagging, all hardware is functioning properly, and all doors are caulked and sealed as specified. Confirm that speed of travel is approximately 1 fps smoothly for total height of opening. Demonstrate safety device a minimum of five occurrences with some type of artificial obstruction or actual obstruction which could occur through normal use on this project.

3.7 PROTECTION

A. All doors, frames, and exposed hardware shall be adequately protected from damage and/or staining during the progress of the project. Protective covering shall be left intact until Engineer/Architect requests removal or when the project is turned over to the Owner.

END OF SECTION

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SECTION 08 36 13

SECTIONAL OVERHEAD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the sectional overhead doors in accordance with the plans and as specified herein.

B. **This section includes sectional overhead doors**, as follows:

1. Steel frame and steel panels.
2. Manually operated doors.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the sectional overhead doors in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Manufacturer Qualifications**. Provide each sectional overhead door as a complete unit produced by a single manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, operators, and installation accessories.

C. **Inserts and Anchorages**. Furnish inserts and anchoring devices that must be set in concrete or built into masonry for unit installation. Provide setting drawings, templates, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

D. **Miscellaneous**. See concrete and masonry sections for instruction on installing inserts and anchorage devices.

E. **Wind Loading**. Design and reinforce sectional overhead doors to withstand a 20-pound-per-square-foot (psf) wind loading pressure.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** according to Conditions of the Contract and Division 1 specification sections.

1. Product data, roughing-in diagrams, and installation instructions for each type and size of overhead door. Include manufacturer's operating instructions and maintenance data.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

Not used.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **ACCEPTABLE MANUFACTURERS**

A. **Manufacturer**. Subject to compliance with requirements, provide products by one of the following:

1. Clopay Overhead Door Co.
2. Raynor Garage Door Co.
3. Wayne/Dalton Corp.
4. Overhead Door Corp.

2.2 **STEEL SECTIONS**

A. **Door Sections**. Construct door sections from galvanized, structural quality carbon steel sheets complying with American Society for Testing and Materials (ASTM) A 446, Grade A, or ASTM A 526, with a minimum yield strength of 33,000 pounds per square inch (psi), and a minimum G60 zinc coating complying with ASTM A 525.

1. Steel Sheet Thickness. 0.015 inch.
2. Exterior Section Face. Ribbed or fluted.

B. **Fabricate sections from a single sheet** to provide units not more than 24 inches high, and nominally 2 inches deep. Roll horizontal meeting edges to a continuous shiplap, rabbeted, or keyed weather seal, with a reinforcing flange return.

C. **Framing**. Enclose open section with 16 gauge galvanized steel channel, end stiles welded in place. Provide intermediate stiles, cut to door section profile, spaced at not more than 48 inches on center (o.c.) and welded in place.

D. **Reinforcement**. Reinforce bottom section with a continuous channel or angle conforming to bottom section profile.

1. Reinforce sections with continuous horizontal and diagonal reinforcing, as required by door width and design wind loading. Provide galvanized steel bars, struts, trusses or strip steel, formed to depth, and bolted or welded in place.

E. **Insulation**. Insulate inner core of steel sections with manufacturer's standard glass fiber, polystyrene, or polyurethane foam-type insulation.

1. Enclose insulation with manufacturer's standard steel sheet secured to door panel.

F. **Finish door sections** as follows:

1. Apply manufacturer's standard prime and finish coats, applied to interior and exterior door faces.

2.3 WOOD SECTIONS

Not Used.

2.4 ALUMINUM SECTIONS

Not Used.

2.5 FIBERGLASS TRANSLUCENT SECTIONS

Not Used.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

A. **Tracks**. Provide manufacturer's standard, galvanized steel track system, sized for door size and weight, and designed for clearances shown. Provide complete track assembly including brackets, bracing and reinforcing for rigid support of ball bearing roller guides for required door type and size. Slot vertical sections of track at 2 inches o.c. for door drop safety device. Slope tracks at proper angle from vertical, or otherwise design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.

B. **Track Reinforcement and Supports**. Provide galvanized steel track reinforcement and support members. Secure, reinforce and support tracks as required for size and weight of door to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.

C. **Support and attach tracks** to opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling tracks) with continuous angle welded to track and supported by laterally braced attachments to overhead structural members at curve and end of tracks.

D. **Weather Seals**. Provide continuous rubber, neoprene, or flexible vinyl adjustable weather-strip gasket at tops and compressible astragal on bottoms of each overhead door.

2.7 HARDWARE

A. **General**. Provide heavy-duty, rust-resistant hardware, with galvanized or cadmium-plated or stainless steel fasteners, to suit type of door.

B. **Hinges**. Provide heavy steel hinges at each end stile and at each intermediate stile, per manufacturer's recommendations for size of door. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges, where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.

C. **Rollers**. Provide heavy-duty rollers, with steel ball bearings in case hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide roller tires to suit size of track (3-inch diameter for 3-inch track; 2-inch diameter for 2-inch track) and as follows:

1. Neoprene or bronze tires for hazardous atmospheres.

D. **Pull Handles, Locks and Latches**. For manually operated doors, furnish lifting handles, locks, and locking device as follows:

1. Lifting Handles. Galvanized steel.
2. Locking Bars. Single side, operable from inside only.

E. **Fabricate locking device assembly** with mortise lock, spring-loaded dead bolt, chromium-plated operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.

2.8 COUNTERBALANCING MECHANISM

A. **Torsion Spring**. Operation by torsion spring counterbalance mechanism, consisting of adjustable tension, tempered steel torsion springs mounted on a cross header tube or steel shaft. Connect to door with galvanized aircraft type lift cables. Provide springs calibrated for 10,000 cycles minimum.

B. **Provide cast aluminum or gray iron casting** cable drums, grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball bearing brackets at each end of shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one third points to support shafts over 16 feet long, unless closer spacing recommended by door manufacturer.

C. **Include a spring loaded, steel or bronze cam** mounted to bottom door roller assembly on each side, designed to automatically stop door if either cable breaks.

D. **Provide a spring bumper** at each horizontal track to cushion door at end of opening operation.

2.9 MANUAL DOOR OPERATION

A. **Push-Up**. Provide lift handles and pull rope for raising and lowering doors, operating with not more than 25-pound lift or pull.

2.10 ELECTRIC DOOR OPERATORS

Note Used.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**. Install door, track, and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports according to shop drawings, manufacturer's instructions, and as specified.

B. **Fasten vertical track assembly** to framing at not less than 24 inches o.c. Hang horizontal track from structural overhead framing with angle or channel hangers, welded and bolt fastened in place. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door operating equipment.

C. **After completing installation**, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

END OF SECTION

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SECTION 08 41 00

ALUMINUM STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install aluminum and storefronts in accordance with the plans and as specified herein.

B. **This section** includes the following types of aluminum storefront work:

1. Storefront type framing system.

C. **Related Sections.** The following sections contain requirements that relate to this section:

1. Glazing requirements for aluminum and storefront, including entrances specified to be factory glazed, are included in Division 8 section "Glass and Glazing."

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install aluminum and storefronts in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Installer Qualifications.** Engage an experienced installer who has completed installations of aluminum storefront and entrances similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.

C. **Manufacturer Qualifications.** Provide aluminum entrances and storefront systems produced by a firm experienced in manufacturing systems that are similar to those indicated for this project and that have a record of successful in-service performance.

D. **Fabricator Qualifications.** Provide aluminum entrances and storefront systems fabricated by a firm experienced in producing systems that are similar to those indicated for this project, and that have a record of successful in-service performance. The fabricator shall have sufficient production capacity to produce components required without causing delay in progress of the work.

E. **Single Source Responsibility.** Obtain aluminum entrance and storefront systems from one source and from a single manufacturer.

F. **Design Criteria.** The drawings indicate the size, profile, and dimensional requirements of aluminum entrance and storefront work required and are based on the specific types and models indicated. Aluminum entrance and storefront by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Engineer/Architect. The burden of proof of equality is on the proposer.

1.4 SUBMITTALS

A. **General.** Submit the following in accordance with Conditions of the Contract and Division 1 specification sections.

1. Product data for each aluminum storefront system required, including:

   a. Manufacturer's standard details and fabrication methods.
   b. Data on finishing, hardware and accessories.
   c. Recommendations for maintenance and cleaning of exterior surfaces.

2. Shop drawings for each aluminum storefront system required, including:

   a. Layout and installation details, including relationship to adjacent work.
   b. Elevations at 1/4 inch scale.
   c. Detail sections of typical composite members.
   d. Anchors and reinforcement.
   e. Provisions for expansion and contraction.
   f. Glazing details.

3. Samples for Initial Color Selection. Submit pairs of samples of each specified color and finish on 12 inch long sections of extrusions or formed shapes. Where normal color variations are anticipated, include two or more units in each set of samples indicating extreme limits of color variations.

4. Samples for Verification Purposes. The Engineer/Architect reserves the right to require additional samples, that show fabrication techniques and workmanship, and design of hardware and accessories.

5. Test Reports. Provide certified test reports from a qualified independent testing laboratory showing that aluminum storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

1.5 JOB CONDITIONS

A. **Field Measurements.** Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work.

1. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver aluminum entrance and storefront components** in the manufacturer's original protective packaging.

B. **Store aluminum components** in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.

1. Stack framing components in a manner that will prevent bending and avoid significant or permanent damage.

1.7 SPECIAL WARRANTY

A. **Warranty.** Submit a written warranty, executed by the manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to:

1. Structural failures including excessive deflection, excessive leakage or air infiltration.
2. Faulty operation.
3. Deterioration of metals, metal finishes and other materials beyond normal weathering.

B. **Warranty Period.** 3 years after the date of Substantial Completion.

C. **Owner's Rights**. The warranty shall not deprive the Owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.8 SYSTEM PERFORMANCE REQUIREMENTS

A. **General.** Provide aluminum entrance and storefront assemblies that comply with performance characteristics specified, as demonstrated by testing the

manufacturer's corresponding stock assemblies according to test methods indicated.

B. **Thermal Movement.** Design the aluminum entrance and storefront framing systems to provide for expansion and contraction of the component materials. Entrance doors shall function normally over the specified temperature range.

1. The system shall be capable of withstanding a metal surface temperature range of 180 degrees Fahrenheit (° F.) (100 degrees Celsius [° C.]) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.

C. **Design Requirements.** Provide aluminum entrance and storefront systems that comply with structural performance, air infiltration, and water penetration requirements indicated.

1. Wind Loads. Provide aluminum entrance and storefront assemblies capable of withstanding wind pressures of 20 pounds per square foot (psf) inward and 20 psf outward acting normal to the plane of the wall.

D. **Structural Performance.** Conduct tests for structural performance in accordance with American Society for Testing and Materials (ASTM) E 330. At the conclusion of the tests there shall be no glass breakage or permanent damage to fasteners, anchors, hardware or actuating mechanism. Framing members shall have no permanent deformation in excess of 0.2 percent of their clear span.

1. Deflection Normal to the Plane of the Wall. Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the wind load specified above. Deflection shall not exceed 1/175 of the clear span, when subjected to uniform load deflection test.

2. Deflection Parallel to the Plane of the Wall. Test pressures required to measure deflection parallel to the plane of the wall shall be equal to 1.5 times the wind pressures specified above. Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 75 percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other fixed member above to less than 1/8 inch. The clearance between the member and an operable door or window shall be at least 1/16 inch.

E. **Air Infiltration.** Provide aluminum entrance and storefront framing system with an air infiltration rate of not more than 0.06 cubic feet per minute (cfm) per square foot (psf) of fixed area (excluding operable door edges) when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.57 psf.

F. **Water Penetration.** Provide framing systems with no uncontrolled water penetration (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 6.24 psf.

G. **Condensation Resistance.** Where framing systems are "thermal break" construction, provide units tested for thermal performance in accordance with AAMA 1503 showing condensation resistance factor (CRF) of not less than 45.

H. **Thermal Transmittance.** Provide framing systems that have an overall U value of not more than 0.65 British thermal unit (BTU)/(hour x sf x º F.) at 15 miles per hour (mph) velocity when tested in accordance with AAMA 1503.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering entrance and storefront systems that may be incorporated in the work include, but are not limited to, the following:

1. EFCO Corporation.
2. Kawneer Company, Inc.
3. United States Aluminum Corp.

2.2 MATERIALS

A. **Aluminum Members.** Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for aluminum extrusions, ASTM B 209 for aluminum sheet or plate, and ASTM B 211 for aluminum bars, rods and wire.

B. **Carbon steel reinforcement of aluminum framing members** shall comply with ASTM A 36 for structural shapes, plates and bars, ASTM A 611 for cold rolled sheet and strip, or ASTM A 570 for hot rolled sheet and strip.

C. **Glass and Glazing Materials.** Comply with requirements of "Glass and Glazing" section of these specifications.

D. **Fasteners.** Provide fasteners of aluminum, nonmagnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components.

1. Reinforcement. Where fasteners screw anchor into aluminum members less than 0.125 inches thick, reinforce the interior with aluminum or

nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.

2. Exposed Fasteners. Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat head machine screws that match the finish of member or hardware being fastened.

E. **Concealed Flashing.** 0.0179 inch (26 gauge) minimum dead soft stainless steel, or 0.026 inch thick minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.

F. **Brackets and Reinforcements.** Provide high strength aluminum brackets and reinforcements; where use of aluminum is not feasible provide nonmagnetic stainless steel or hot dip galvanized steel complying with ASTM A 123.

G. **Concrete and Masonry Inserts.** Provide cast iron, malleable iron, or hot dip galvanized steel inserts complying with ASTM A 123.

H. **Compression Weatherstripping.** Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.

I. **Sliding Weatherstripping.** Manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.

2.3 COMPONENTS

A. **Storefront Framing System.** Provide storefront and entrance framing systems fabricated from extruded aluminum members of size and profile indicated. Include subframes and other reinforcing members of the type indicated. Provide for flush glazing storefront from the exterior on all sides without projecting stops. Shop fabricate and preassemble frame components where possible. Provide storefront frame sections without exposed seams.

1. Mullion Configurations. Provide pockets at the inside glazing face to receive resilient elastomeric glazing. Mullions and horizontals shall be one piece. Make provisions to drain moisture accumulation to the exterior.

2.4 FABRICATION

A. **General.** Fabricate aluminum entrance and storefront components to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes and profile requirements are indicated on the drawings. Variable dimensions are indicated, with maximum and minimum dimensions required, to achieve design requirements and coordination with other work.

1. Thermal Break Construction. Fabricate storefront framing system with an integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal-to-metal contact. Use manufacturer's standard construction that has been in use for similar projects for period of not less than 3 years.

B. **Prefabrication.** Complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible before shipment to the project site. Disassemble components only as necessary for shipment and installation.

1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete these operations for hardware prior to application of finishes.

C. **Welding.** Comply with AWS recommendations. Grind exposed welds smooth to remove weld spatter and welding oxides. Restore mechanical finish.

1. Welding behind finished surfaces shall be performed in such a manner as to minimize distortion and discoloration on the finished surface.

D. **Dissimilar Metals.** Separate dissimilar metals with bituminous paint, or a suitable sealant, or a nonabsorptive plastic or elastomeric tape, or a gasket between the surfaces. Do not use coatings containing lead.

E. **Continuity.** Maintain accurate relation of planes and angles with hairline fit of contacting members.

1. Uniformity of Metal Finish. Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.

F. **Fasteners.** Conceal fasteners wherever possible.

2.5 FINISHES

A. **General.** Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. **Finish designations prefixed by "AA"** conform to the system established by the Aluminum Association for designating aluminum finishes.

C. **Finish aluminum storefronts** to match other adjacent glazed aluminum curtain wall components. Refer to "Glazed Aluminum Curtain Wall" section for finish requirements.

D. **Class I Color Anodized Finish.** AA-M12C22A42/A44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, film thicker than 0.7 mil with integral color or electrolytically deposited color) complying with AAMA 606.1 or AAMA 608.1.

1. Color. As selected by Engineer/Architect from within standard industry colors and color density range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **General.** Examine substrates and supports, with the Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of aluminum storefronts. Correct unsatisfactory conditions before proceeding with the installation.

1. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. **General.** Comply with manufacturer's instructions and recommendations for installation.

B. **Set units plumb, level, and true to line**, without warp or rack of framing members, doors, or panels. Install components in proper alignment and relation to established lines and grades indicated. Provide proper support and anchor securely in place.

C. **Construction Tolerances**. Install aluminum entrance and storefront to comply with the following tolerances:

1. Variation from Plane. Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
2. Offset from Alignment. The maximum offset from true alignment between two identical members abutting end to end in line shall not exceed 1/16 inch.
3. Diagonal Measurements. The maximum difference in diagonal measurements shall not exceed 1/8 inch.
4. Offset at Corners. The maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

D. **Separate aluminum and other corrodible metal surfaces** from sources of corrosion or electrolytic action at points of contact with other materials.

1. Zinc or cadmium plate steel anchors and other unexposed fasteners after fabrication.
2. Paint dissimilar metals where drainage from them passes over aluminum.

3. Paint aluminum surfaces in contact with mortar, concrete or other masonry with alkali resistant coating.
4.

E. **Drill and tap frames and doors and apply surface mounted hardware items**. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

F. **Set sill members and other members** in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division 7 for sealants, fillers, and gaskets.

G. **Refer to "Glass and Glazing" section** of Division 8 for installation of glass and other panels indicated to be glazed into doors and framing, and not preglazed by manufacturer.

3.3 ADJUSTING

A. **General.** Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.

3.4 CLEANING

A. **Clean the completed system, inside and out**, promptly after installation, exercising care to avoid damage to coatings.

B. **Clean glass surfaces after installation**, complying with requirements contained in the "Glass and Glazing" section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

3.5 PROTECTION

A. **General.** Institute protective measures required throughout the remainder of the construction period to ensure that aluminum storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

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SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glazed aluminum curtain walls.

B. Related Requirements:

1. Section 08 80 00 “Glazing” for glazing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
3. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
4. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.
5. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

B. Samples for Initial Selection: For units with factory-applied color finishes.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

    1. Joinery, including concealed welds.
    2. Anchorage.
    3. Expansion provisions.
    4. Glazing.
    5. Flashing and drainage.

E. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and laboratory mockup testing agency and field testing agency.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

C. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

D. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

A. Special Assembly Warranty: Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including, but not limited to, excessive deflection.
    b. Noise or vibration created by wind and thermal and structural movements.
    c. Deterioration of metals[, metal finishes,] and other materials beyond normal weathering.
    d. Water penetration through fixed glazing and framing areas.
    e. Failure of operating components.
2. Warranty Period: 5 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch (6. 35-mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:
    a. Maximum air leakage of 0.04 cfm/sq. ft at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20

percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
2. Maximum Water Leakage: According to AAMA 501.1 No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

I. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: H/400 (0.42’ per story).
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

J. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.

K. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.

L. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows:

1. Outdoor-Indoor Transmission Class: Minimum 30.

M. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

2.2 MANUFACTURERS

A. Basis of Design: Kawneer 1600.

B. Source Limitations: Obtain all components of curtain wall system, including framing spandrel panels, sun control and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: High-performance organic finish.
5. Fabrication Method: Either factory- or field-fabricated system.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
    b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
    c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
    a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCES

A. Entrances: Comply with Section 08 41 13 "Aluminum-Framed Entrances and Storefronts."

2.5 SUN CONTROL

A. Sunshades: Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to curtain wall with mechanical fasteners.

1. Orientation: Vertical.
2. Projection from Wall: As indicated on Drawings.
3. Finish: Match adjacent glazed aluminum curtain wall.

B. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
    b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
    c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    d. Structural Profiles: ASTM B 308/B 308M.

2.6 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 08 80 00 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 08 80 00 "Glazing."

F. Install weatherseal sealant according to Section 07 92 00 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:
    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    a. Perform a minimum of three tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
    a. `
3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 08 45 23

FIBERGLASS-SANDWICH TRANSLUCENT PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. **General.** Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:

1. Wall assemblies.

1.3 SUBMITTALS

A. **Product Data.** For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.

B. **Shop Drawings.** For panel assemblies. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

C. **Samples for Initial Selection.** For units with factory-applied color finishes.

D. **Fabrication Samples.** Of each framing system intersection and adjacent panels, made from 12-inch lengths of full-size framing members and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Fiberglass-sandwich panels.
5. Flashing and drainage.

E. **Qualification Data.** For qualified Installer manufacturer.

F. **Product Test Reports.** Based on evaluation of comprehensive tests performed by a qualified testing agency, for panel assemblies.

G. **Maintenance Data.** For panel assemblies to include in maintenance manuals.

H. **Warranties.** Sample of special warranties.

1.4 QUALITY ASSURANCE

A. **Manufacturer Qualifications.** For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04, "Sandwich Panels," or ICC-ES AC177, "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems."

B. **Installer Qualifications.** Manufacturer's authorized representative who is trained and approved for installation of panel assemblies required for this Project.

1.5 WARRANTY

A. **Special Warranty.** Manufacturer's standard form in which manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including, but not limited to, excessive deflection.
    b. Deterioration of metals and other materials beyond normal weathering.
    c. Water leakage.

2. Warranty Period: Five years from date of Substantial Completion.

B. **Special Fiberglass-Sandwich-Panel Warranty.** Manufacturer's standard form in which manufacturer agrees to replace panels that exhibit defects in materials or workmanship.

1. Defects include, but are not limited to, the following:

    a. Fiberbloom.
    b. Delamination of coating, if any, from exterior face sheet.
    c. Color change exceeding requirements.
    d. Delamination of panel face sheets from panel cores.

2. Warranty Period: 10 years from date of Substantial Completion.

C. **Special Aluminum-Finish Warranty.** Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Manufacturers.** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. **Basis-of-Design Product.** Subject to compliance with requirements, provide Kalwall or comparable product by one of the following:

1. Kalwall Corporation.
2. Major Industries, Inc.
3. Skywall Translucent Systems; Vistawall Group (The).
4. Structures Unlimited, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. **General Performance.** Fiberglass-sandwich-panel assemblies shall withstand the effects of the following forces without failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes, but is not limited to, the following:

    a. Deflection exceeding specified limits.
    b. Water leakage.
    c. Thermal stresses transferred to building structure.
    d. Noise or vibration created by wind, thermal, or structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.

B. **Structural Loads.**

1. Seismic Loads: As indicated on Drawings.
2. Wind Loads:

    a. As indicated on the structural drawings.

C. **Deflection Limits.**

1. Vertical Panel Assemblies: Limited to 1/60 of clear span for each assembly component.
2. Overhead Panel Assemblies: Limited to 1/60 of clear span for each assembly component.

D. **Water Penetration under Static Pressure.** Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

E. **Thermal Movements.** Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 100 deg F, material surfaces.

F. **Energy Performance.** Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.23 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar-Heat-Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than .32 as determined according to NFRC 200.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.

2.3 ALUMINUM FRAMING SYSTEMS

A. **Components.** Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken, extruded aluminum.

B. **Aluminum.** Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
4. Structural Profiles: ASTM B 308/B 308M.

C. **Brackets and Reinforcements.** Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. **Fasteners and Accessories.** Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A 193/A 193M, 300 series stainless-steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. **Concrete and Masonry Inserts.** Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. **Anchor Bolts.** ASTM A 307, Grade A, galvanized steel.

G. **Concealed Flashing.** Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. **Exposed Flashing and Closures.** Aluminum sheet not less than 0.040 inch thick, finished to match framing.

I. **Framing Gaskets.** Manufacturer's standard.

J. **Frame-System Sealants.** As recommended in writing by manufacturer.

K. **Corrosion-Resistant Coating.** Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 FIBERGLASS-SANDWICH PANELS

A. **Description.** Assembly of uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

1. Self-Ignition Temperature: 650 deg F or more per ASTM D 1929.
2. Smoke-Developed Index: 450 or less per ASTM E 84, or 75 or less per ASTM D 2843.
3. Flame-Spread Index: Not more than 25 per ASTM E 84.
4. Combustibility Classification: Class CC1 per ASTM D 635.
5. Interior Finish Classification: Class A per ASTM E 84.

B. **Panel Thickness.** 2-3/4 inches.

C. **Panel Strength Characteristics.**

1. Maximum Panel Deflection: 3-1/2 inches when a 4-by-12-foot panel is tested according to ASTM E 72 at 34 lbf/sq. ft., with a maximum 0.090-inch set deflection after five minutes.
2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf concentrated load when applied to a 3-inch- diameter disk according to ASTM E 661.

D. **Grid Core.** Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.

1. Extruded Aluminum: ASTM B 221, in alloy and temper recommended in writing by manufacturer.
2. I-Beam Construction: Thermally broken, extruded aluminum.
3. Grid Pattern: Inline rectangle, nominal 12 by 24 inches.

E. **Exterior Face Sheet.**

1. Thickness: 0.070 inches.
2. Color: Crystal.
3. Color Change: Not more than 3.0 units Delta E when measured according to ASTM D 2244, after outdoor weathering in southern Florida compliant with procedures in ASTM D 1435, with panels mounted facing south and as follows:

    a. Panel Mounting Angle: Not more than 45 degrees from horizontal.
    b. Exposure Period: 60 months.

4. Erosion Protection: Integral, embedded-glass erosion barrier.
5. Impact Resistance: No fracture or tear at impact of 70 ft. x lbf by a 3-1/4-inch- diameter, 5-lb freefalling ball according to UL 972 test procedure.

F. **Interior Face Sheet.**

1. Thickness: 0.045 inch.
2. Color: Crystal.

G. **Fiberglass-Sandwich-Panel Adhesive.** ASTM D 2559.

1. Compatible with facing and core materials.
2. Tensile and shear bond strength of aged adhesive ensures permanent adhesion of facings to cores, as evidenced by testing tensile strength according to ASTM C 297 and shear bond strength according ASTM D 1002. Use accelerated aging procedures that comply with aging requirements for adhesives with high resistance to moisture in ICC-ES AC05, "Sandwich Panel Adhesives."

2.5 FABRICATION

A. **Frame System Fabrication.**

1. Fabricate components before finishing.
2. Fabricate components that, when assembled, have the following characteristics:

    a. Profiles that are sharp, straight, and free of defects or deformations.
    b. Accurately fitted joints with ends coped or mitered.
    c. Internal guttering systems or other means to drain water passing through joints, condensation occurring within components, and moisture migrating within assembly to exterior.

3. Fabricate sill closures with weep holes and for installation as continuous component.
4. Reinforce components as required to receive fastener threads.

B. **Panel Fabrication.** Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.

a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.

2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

2.6 ALUMINUM FINISHES

A. **High-Performance Organic Finish.** Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine.** Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. **Proceed**. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. **General.**

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
6. Seal joints watertight unless otherwise indicated.

B. **Metal Protection.** Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. **Install continuous aluminum sill closures** with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters.

D. **Install components to drain water** passing through joints, condensation occurring within aluminum members and panels, and moisture migrating within assembly to exterior.

E. **Install components plumb** and true in alignment with established lines and elevations.

F. **Erection Tolerances.** Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

END OF SECTION

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the aluminum windows in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies.** Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards.** All materials and workmanship shall be in conformance with the following standards.

1. AA - Aluminum Association.

C. **Qualifications**. Aluminum windows and accessories shall be manufactured by a single firm specializing in the production of this type of work.

1.4 SUBMITTALS

A. **Shop Drawings**. Submit shop drawings showing materials, types, sizes, connections, anchorage, protection, weather stripping seals, glazing beads, finish hardware, and all other details of construction and fabrication. Fabrication and erection shall be in accordance with the approved shop drawings.

B. **Warranty**. Submit manufacturer's warranty in accordance with paragraph 1.7 A of this specification.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate all work with other trades to prevent delays, errors, and/or omissions.

B. **Openings**. Opening dimensions shown are actual masonry and/or concrete openings. Windows shall be undercut 1/4 inch to allow for leveling and caulking.

C. **Protection**. The factory is to apply a heavy coat of alkali resistant epoxy paint to portions of the aluminum which come in contact with the masonry, concrete, steel, or other dissimilar metals. Any field applied coating shall be as furnished by the manufacturer. All units shall be field protected from damage and staining during construction. Units not factory taped or protected shall be protected with a strippable coating of detergent, shaving soap, or petroleum jelly which will be removed prior to caulking.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver all windows in time for installation. Keep in protective covers and clearly note as to size, type, and mark number.

B. **Storage**. All windows and accessories shall be stored in strict compliance with the manufacturer's instructions.

C. **Handling**. All units shall be kept protected until used. Handle to prevent damage to unit, finish, and seals.

PART 2 PRODUCTS

2.1 MATERIALS

A. **Framing.** All window framing, mullions, muttins, subframe, and blocking shall be 6063 extruded aluminum.

B. **Weather Stripping.** Weather stripping shall be neoprene rubber.

C. **Hardware.** Screws, nuts, bolts, rivets, and reinforcements shall be aluminum or nonmagnetic stainless steel. Coated or plated material will not be accepted. All exposed hardware shall be white bronze finished to match the window. All strikes shall be concealed and of nonmagnetic stainless steel.

D. **Screens.** Screens shall be 14 x 18 mesh aluminum wire fabric mounted in a 6063 aluminum frame complete with all necessary hardware.

2.2 WINDOWS

A. **Type**. Windows except where noted otherwise shall be fixed type thermo-barrier, of the size and style shown.

B. Construction

1. Fixed Type. Frame members shall be a minimum of 4-1/2 inches in depth with a wall thickness not less than 0.125 inches. All members shall be extruded as a single section. Frame members shall be mechanically joined and factory sealed to form a watertight joint.

2. Projected Type. Frame and sash members shall be a minimum of 2 1/2 inches in depth with a wall thickness not less than 0.125 inches. All members shall be extruded as a single section. Sash members shall be constructed with mitered corners reinforced with aluminum corner blocks, cold welded with an epoxy adhesive and hydraulically crimped. Sash shall present a flush condition with the frame. Frame members shall be mechanically joined and factory sealed to form a watertight joint.

C. **Thermal Barrier**. A thermal separator of polyurethane or polyvinyl chloride shall be poured in place to maintain a minimum of 3/8 inch separation between the exterior and interior metal surfaces. No hardware or fasteners shall violate this barrier.

D. **Weather Stripping**. Sash and window shall be weather-stripped with two rows of neoprene installed in dovetail grooves extruded in the sash members.

E. **Subframe**. Provide subframe as shown to provide positive anchorage to the masonry and provide complete cover for masonry cavity. Subframe shall not violate thermal features of the window.

F. **Glazing**. Windows shall be designed for outside glazing with screwed on extruded aluminum strips. All screws shall be flat head, countersunk, and set flush.

G. **Hinged Window.** Hinged window shall be provided as a single unit, hinged to operate as a door. Window shall be hinged to subframe with manufacturer's standard components to hold window open. Window shall be gasketed and internally locked. Hinge location shall be as indicated on the drawings.

2.3 FINISH

A. All aluminum, unless noted otherwise, shall have an anodized finish meeting AAMA standards. Color to be selected by the owner.

2.4 MANUFACTURER

A. **Model and Manufacturer**. Subject to compliance with requirements, manufacturers offering windows which may be incorporated in the work include the following:

1. Fixed. Kawneer 8400 TL or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Verify that all dimensions and quantities at the building and be responsible for same.

2. Verify that all openings are complete and ready for window installation.

3.2 INSTALLATION

A. Erection

1. Set all windows and light panels straight, plumb, and true.

2. Position windows and light panels to provide adequate and uniform caulking space on exterior and interior face.

3. Anchor windows securely to subframe and subframe to wall.

4. Set all hardware and accessories in accordance with shop drawings and manufacturer's instructions.

3.3 REPAIR/RESTORATION

A. Damaged Work

1. Remove from the job site all windows that are bowed, twisted, or otherwise unacceptable.

2. All windows and light panels that are scratched, dented, stained, marred, or defaced that cannot be restored to original condition or to the satisfaction of the Owner and Engineer/ Architect, shall be removed from the job site and replaced at no additional cost to the Owner.

3.4 FIELD QUALITY CONTROL

A. **Manufacturer's Field Service.** After completion and prior to acceptance of the windows, a manufacturer's representative shall adjust and true each window to ensure ease of operation and ensure a positive weather seal.

3.5 CLEANING

A. At the completion of the project, windows and light panels shall be cleaned as recommended by the manufacturer. The Contractor shall remove all field applied protection and be responsible for any damage resulting from other cleaning methods. No abrasive cleaning agents shall be used.

3.6 DEMONSTRATION

A. **Operational.** The Contractor shall demonstrate to the Owner and Engineer/Architect that all operating sash operates freely, uniformly, and easily without binding, twisting, or sagging.

B. **Seals.** The Contractor shall demonstrate to the Owner and Engineer/Architect that all seals and caulking are functioning by spraying each unit with water for not less than 3 minutes at a minimum rate of 0.33 gallons per minute (gpm) per square foot with no water infiltration through the window.

C. **Water.** Water will be furnished by the Owner for the initial test only. All failures that have to be retested will be at the Contractor's expense.

END OF SECTION

SECTION 08 64 00

PLASTIC UNIT SKYLIGHTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the plastic unit skylights in accordance with the plans and as specified herein. All new skylights installed shall be equipped with a skylight protection screen as detailed herein.

B. **This section includes** plastic unit skylights.

C. **Related Sections**. The following sections contain requirements that relate to this section:

1. Division 6 section "Rough Carpentry" for wood curbs and nailers.

2. Division 7 section "Roof Specialties:" Roof edge flashings and drainage systems.

3. Division 7 section "Flashing and Sheet Metal" for metal flashing for skylights.

D. **Refer to roofing system sections** for roofing accessories to be built into the roofing system to accommodate work of this section.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the plastic unit skylights in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Fire-Test Response Characteristics**. Provide plastic sheets identical to those tested for the following fire test response characteristics, per American Society for Testing and Materials (ASTM) test method indicated below, by Underwriters' Laboratories, Inc. (UL) or other testing and inspecting agencies acceptable to authorities having jurisdiction. Identify plastic sheets with appropriate markings of applicable testing and inspecting organization.

1. Self-Ignition Temperature. 650 degrees Fahrenheit (° F.) (343.33 degrees Celsius [° C.]) or greater when tested per ASTM D 1929 on plastic sheets in the thickness intended for use.

2. Smoke density of 75 or less when tested per ASTM D 2843 on plastic sheets in the thickness intended for use.

3. Relative Burning Characteristics. As follows, when tested per ASTM D 635:

a. Acrylic. Burning rate of 2.5 inches per minute or less when tested on plastic glazing indicated below with a nominal thickness of 0.060 inch or the thickness intended for use.

4. The Skylight Protection Screen shall be tested to a 200 Ib Static Load.

1.4 SUBMITTALS

A. **Submit the following** according to the Conditions of Contract and Division 1 specification sections.

1. Product data for each type of skylight specified, including details of construction relative to materials, dimensions of individual components, profiles, finishes, and glazing light transmission and thermal characteristics.

2. Shop drawings showing fabrication and installation of skylights, including plans, elevations, sections, details of components, and attachments to other units of work.

3. Samples for initial selection purposes in the form of manufacturer's color charts showing a full range of colors available for each type of skylight glazing, retainer, frame, and curb indicated

4. Include details of construction and installation of the Skylight Protection Screen.

1.5 JOB CONDITIONS

A. Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Not used.

1.7 SPECIAL WARRANTY

A. **General**. Warranties specified in this section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. **Skylight Warranty**. Provide written warranty signed by manufacturer, agreeing to repair or replace work that exhibits defects in materials or workmanship and guaranteeing weathertight and leak free performance. "Defects" is defined as uncontrolled leakage of water and abnormal aging or deterioration.

1. Warranty Period. Five years from date of Substantial Completion.

C. **Plastic Warranty**. Provide written warranty signed by manufacturer agreeing to repair or replace work that has or develops defects in the plastic. "Defects" is defined as abnormal aging or deterioration.

1. Warranty Period for Acrylic. Five years from date of Substantial Completion against yellowing

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Bristolite Skylights.
2. Fiore Skylights, Inc.
3. Naturalite/EPI Skylight Systems.
4. Sunglo Skylight Products.
5. Wasco Products, Inc.

2.2 MATERIALS

A. **Aluminum Sheets**. ASTM B 209 for Alclad alloy 3005-H25 or alloy and temper required to suit forming operations and finish requirements. Mill finish unless indicated otherwise.

B. **Extruded Aluminum**. ASTM B 221 alloy 6063-T52 or alloy and temper required to suit structural and finish requirements. Mill finish unless indicated otherwise.

C. **Plastic Sheets**. Monolithic, formable, transparent (colorless and tinted) or translucent (white) sheets with good weather and impact resistance.

1. Acrylic. ASTM D 4802, thermoformable, cast or continuous cast acrylic (methacrylate), Category C-1 or C-2, Type UVA (formulated with ultraviolet absorber), with Finish 1 (smooth or polished), unless otherwise indicated.

D. **Wood Curbs and Nailers**. Softwood lumber, pressure treated with waterborne preservatives for above ground use, complying with American Wood Preservers Association (AWPA) C2; not less than 1-1/2 inch nominal thickness.

E. **Fasteners**. Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

F. **Bituminous Coating**. Steel Structures Painting Council (SSPC)-Paint 12, solvent type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15 mil dry film thickness per coating.

G. **Mastic Sealant**. Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

H. **Elastomeric Sealant**. Generic type recommended by unit manufacturer that is compatible with joint surfaces. ASTM C 920; Type S; Grade NS; Class 25; and Uses NT, G, A, and (as applicable to joint substrates indicated) O.

I. **Roofing Cement**. ASTM D 4586, nonasbestos fibrated, asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 FINISHES

A. **General**. Comply with National Association of Architectural Metal Manufacturers (NAAMM) "Metal Finishes Manual" recommendations for application and designations of finishes.

B. **Finish designations prefixed by AA** conform to the system for designating aluminum finishes established by the Aluminum Association (AA).

C. **Class I, Clear Anodized Finish**. AA-C22A41 (Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, clear film thicker than 0.7 mil) complying with American Architectural Manufacturers Association (AAMA) AAMA 607.1.

2.4 PLASTIC SKYLIGHT UNITS

A. **General**. Factory-assembled unit consisting of plastic glazing, extruded aluminum glazing retainer, gasketing, inner frame that may be incorporated into the curb, and integral curb with self-contained roof flashing flanges.

B. **Curb**. Self-flashing, self-supporting double wall, formed or extruded (or combination) aluminum curb, minimum 0.040 inch wall thickness, enclosing minimum 1 inch glass fiber board (or equivalent) insulation and with minimum 3 inch roof flanges, with welded or sealed mechanical joints at corners.

1. Height. 9 inches above roofing.

2. Taper. Where roof deck slopes more than 1/4 inch per foot, provide tapered curb heights to match slope and result in level dome installation.

C. **Condensation Control**. Fabricate skylight units with integral internal gutters and nonclogging weeps to collect and dispose of condensation.

D. **Thermal Break**. Fabricate skylight units with thermal barrier separating interior metal framing from materials exposed to outside temperature.

E. **Operable Skylight Vent**. Equip unit with hinges, operating hardware, and weather sealing gaskets.

F. **Shape and Size**. As indicated.

G. **Glazing**. Thermoformed acrylic.

1. Sheet Thicknesses. Provide glazing plastic sheet thickness required for 40 pounds per foot (lb/f) per square foot (psf) positive (external) loading and 20 lbf psf negative or uplift (internal) loading as recommended by the skylight manufacturer for unit size and shape.

2. Profile. Double dome, 25-percent rise.

a. Outer Glazing Color. Colorless, transparent acrylic, 92-percent visible light transmittance.

b. Inner Glazing Color. White, No. 2067, translucent acrylic, 72-percent visible light transmittance.

3. Glazing Gaskets. Manufacturer's standard glazing system of EPDM or neoprene, closed cell sponge neoprene, or EPDM, or of partially vulcanized butyl tape or liquid applied elastomeric sealant.

2.5 SKYLIGHT PROTECTION SCREEN

A. Materials:

1. Screen: hot dipped galvanized finish on carbon welded steel wire mesh, 4”x4” spacing, and wire diameter of 0.20” min.

2. Frame: Extruded aluminum alloy per ASTM B221 with minimum effective thickness of 0.1”. Frame shall include a pocket for the edges of the screen material and a downward leg for attachment to any vertical surface of a skylight retainer or frame

3. Adjustment Bar: Aluminum bar stock that is ¼” x 1”, alloy per ASTM B221 (6063-T5 min). Bar shall be slotted for width adjustment in the field.

4. Fasteners: Non-magnetic stainless steel or other non-corrosive metal as recommended by the manufacturer.

B. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealing or tape recommended by the manufacturer.

C. Refer to Contract Drawings for additional requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. **General**. Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive skylight units. Coordinate with installation of vapor barriers, roof insulation, roofing, and flashing as required to assure that each element of the work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

1. Except as otherwise indicated, install roof skylights according to construction details of "NRCA Roofing and Waterproofing Manual."

B. **Isolation**. Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide another permanent separation.

C. **Flange Seals**. Except as otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

D. **Cap Flashing**. Where cap flashing is required as component of the skylight, install to provide an adequate waterproof overlap with roofing or roof flashing (as counterflashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

E. **Operational Units**. Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

F. **Skylight Protection Screen.** Comply with manufacturer’s written instructions for protecting, handling and installing fall protection components.

3.2 CLEANING AND PROTECTION

A. **Clean exposed metal and plastic surfaces** according to manufacturer's instructions. Touch up damaged metal coatings.

END OF SECTION

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SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.

4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual overhead door closer bodies.
4. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Bommer Industries (BO).
b. Hager Companies (HA).
c. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. Bommer Industries (BO).
b. Hager Companies (HA).
c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

a. Burns Manufacturing (BU).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.

3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    c. Trimco (TC).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
1. Manufacturers:

    a. Match Existing, Field Verify.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

E. Construction Keying: Provide construction master keyed cylinders.

F. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.

2. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ML2000 Series.

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as

required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

    1. Manufacturers:

        a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.

C. Security Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed rim panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be constructed of high grade, heat

treated, corrosion resistant nickel steel alloy, and have a full 3/4" throw projection with slide action positive deadlocking.

1. Static Load Force Resistance: Minimum 3000 lbs certified independent tested.

2. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ED4000S / ED5000S Series.

2.8 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

    a. Norton Door Controls (NO) - 7500 Series.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    c. Trimco (TC).

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. Rixson Door Controls (RF).
    b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    c. Sargent Manufacturing (SA).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
3. Reese Enterprises, Inc. (RE).

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and

reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
2. Submit documentation of incomplete items in the following formats:

    a. PDF electronic file.
    b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 08 06 71, Door Hardware Sets, for hardware sets.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. **This Section includes glazing** for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Glazing for windows.
2. Glazing for doors.

1.3 DEFINITIONS

A. **Manufacturers of Glass Products:** Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. **Glass Thicknesses:** Indicated by thickness designations in millimeters according to ASTM C 1036.

C. **Interspace:** Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. **Deterioration of Coated Glass:** Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. **Deterioration of Insulating Glass:** Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 PERFORMANCE REQUIREMENTS

A. **General:** Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and

installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. **Thermal Movements:** Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 ACTION SUBMITTALS

A. **Product Data:** For each glass product and glazing material indicated.

B. **Samples:** For the following products, in the form of 12-inch-square Samples for glass.

1. Insulating glass for each designation indicated.

C. **Glazing Schedule:** Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. **Product Certificates:** Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

1.6 INFORMATIONAL SUBMITTALS

A. **Qualification Data:** For installers.

B. **Preconstruction Adhesion and Compatibility Test Report:** From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

C. **Product Test Reports:** For each of the following types of glazing products:

1. Insulating glass.

D. **Warranties:** Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

A. **Installer Qualifications:** An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. **Source Limitations for Glass:** Obtain the following through one source from a single manufacturer for each glass type: Insulating Glass.

C. **Source Limitations for Glazing Accessories:** Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. . **Glass Product Testing**: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

E. **Elastomeric Glazing Sealant Product Testing**: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

F. **Safety Glazing Products:** Comply with testing requirements in 16 CFR 1201.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

G. **Glazing Publications:** Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA’s “Glazing Manual.”

2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

H. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 01.

1.8 DELIVERY, STORAGE, AND HANDLING

A. **Protect glazing materials according** to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 PROJECT CONDITIONS

A. **Environmental Limitations:** Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.10 WARRANTY

A. **Manufacturer's Special Warranty for Coated-Glass Products:** Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

B. **Manufacturer's Special Warranty on Insulating Glass:** Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Basis-of-Design/Manufacturer Products:** Subject to compliance with requirements, provide products by PPG Industries, Inc. or comparable products by one of the fabricator’s/manufacturer’s following:

1. AFG Industries.
2. Guardian Industries Corp.
3. Oldcastle Glass Corp.
4. Pilkington Building Products (N.A.).
5. Viracom.

2.2 GLASS PRODUCTS

A. **Heat-Treated Float Glass:** ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
4. Provide kind HS (heat strengthened) float glass where indicated.

    a. HS-1: 1/4-inch thick, blue tint, heat strengthened (PPG Vistacool Azuria).

5. Provide Kind FT (fully tempered) where safety glass is indicated.

    a. TG-1: 1/4-inch thick, clear, tempered glass.

    b. TG-2: 1/4-inch Thick, blue tint, tempered glass (PPG Vistacool Azuria).

B. **Insulating-Glass Units, General:** Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified.

1. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
3. Sealing System: Dual seal, with primary and secondary sealants as follows:

    a. Manufacturer's standard sealants.

4. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:

    a. Spacer Material: Manufacturer's standard.
    b. Desiccant: Molecular sieve or silica gel, or blend of both.
    c. Corner Construction: Manufacturer's standard corner construction.

5. Insulating Unit (IG-1): 1-inch thick.

    a. Outboard Lite: 1/4-inch tinted tempered glass (TG-1).
    b. Air Space: 1/2-inch.
    c. Inboard Lite: 1/4-inch clear tempered glass (TG-1) with Low-E coating on surface #3 (PPG Solarban 60).

d. Visible Light Transmittance: 42%.
e. Solar Energy Transmittance: 16%.
f. Ultra-Violet Transmittance: 11%.
g. Visible Light - Exterior Reflectance: 20%
h. Solar Energy Reflectance: 11%.
i. Winter U-Value: 0.30 Btu/(hr x sq.ft. x °F)
j. Summer U-Value: 0.29 Btu/(hr x sq.ft. x °F)
1. Shading Coefficient: 0.30.

m. Solar Factor (SHGC): 0.26.
n. Color selected by owner.
o. Provide tempered glass where required by code.

6. Insulating Unit (IG-2): 1-inch thick:

a. Outboard Lite: 1/4-inch, tinted heat strengthened glass (HS-1).
b. Air Space: 1/2-inch.
c. Inboard Lite: 1/4-inch clear, with Low-E coating on surface #3 (PPG Solarban 60).
d. Visible Light Transmittance: 42%.
e. Solar Energy Transmittance: 16%.
f. Ultra-Violet Transmittance: 11%.
g. Visible Light - Exterior Reflectance: 20%.
h. Solar Energy Reflectance: 11%.
i. Winter U-Value: 0.30 Btu/(hr x sq.ft. x °F).
j. Summer U-Value: 0.29 Btu/(hr x sq.ft. x °F).
1. Shading Coefficient: 0.30.
m. Solar Factor (SHGC): 0.26.
n. Color selected by owner.
o. Ceramic Coated Spandrel Glass. ASTM C 1048, Type I, Condition B, Quality-Q3

7. Interior, Single-pane Glass

a. 1/4-inch clear tempered.

2.3 GLAZING GASKETS

A. **As recommended** by framing manufacturer.

2.4 GLAZING SEALANTS

A. **General:** Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service

and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Associate from manufacturer's full range.

2.5 GLAZING TAPES

A. **As recommended** by framing system manufacturer.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. **General:** Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. **Cleaners, Primers, and Sealers:** Types recommended by sealant or gasket manufacturer.

C. **Setting Blocks:** Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. **Spacers:** Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. **Edge Blocks:** Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.7 FABRICATION OF GLAZING UNITS

A. **Fabricate glazing units** in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine framing glazing,** with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. **Proceed with installation** only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Clean glazing channels and other framing members** receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. **Comply with combined written instructions** of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. **Glazing channel dimensions,** as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. **Protect glass edges from damage during handling and installation.** Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. **Apply primers to joint surfaces** where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. **Install setting blocks** in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. **Do not exceed edge pressures** stipulated by glass manufacturers for installing glass lites.

G. **Provide spacers for glass lites** where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. **Provide edge blocking where** indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. **Set glass lites** in each series with uniform pattern, draw, bow, and similar characteristics.

J. **Where wedge-shaped gaskets are driven** into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. **Square cut wedge-shaped gaskets** at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. **Position tapes on fixed stops** so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. **Install tapes continuously,** but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. **Cover vertical framing joints** by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. **Place joints in tapes at corners of opening** with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. **Do not remove release paper from tape** until just before each glazing unit is installed.

F. **Center glass lites** in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

A. **Fabricate compression gaskets** in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. **Insert soft compression gasket** between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. **Center glass lites** in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. **Install gaskets** so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. **Install continuous spacers,** or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. **Force sealants into glazing channels** to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. **Tool exposed surfaces of sealants** to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. **Protect exterior glass from damage** immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. **Protect glass from contact with contaminating substances** resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. **Examine glass surfaces** adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. **Remove and replace glass** that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. **Wash glass on both exposed surfaces** in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 08 90 00

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the louvers and vents in accordance with the plans and as specified herein.

B. **This section includes the following**:

1. Fixed metal wall louvers.
2. Adjustable metal wall louvers.
3. Acoustical louvers.
4. Blank off panels for wall louvers.
5. Wall vents.

C. **Air intake louvers for heating, ventilating**, and air conditioning (HVAC) terminal units are specified with units in Division 23.

D. **Related Sections.** The following sections contain requirements that relate to this section.

1. Division 7 section "Joint Sealers" for sealants installed in perimeter joints between louver frames and adjoining construction.
2. Division 9 section "Painting" for field painting of louvers.
3. Division 8 section "Steel Doors and Frames" for louvers in hollow metal doors and frames.
4. Division 8 section "Custom Hollow Metal Work" for louvers in hollow metal doors and frames.
5. Division 23 section "Metal Ductwork" for ductwork connected to metal wall louvers.
6. Division 23 section "Electric Control Systems" for electric and electronic control of motor operated adjustable metal wall louvers.
7. Division 26 section "Electrical Connections" for electrical power connections for motor operated adjustable metal wall louvers.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the louvers and vents in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Single-Source Responsibility.** Obtain louvers and vents from a single source where alike in one or more respects with regard to type, design, and factory applied color finish.

C. **Qualify welding processes** and welding operators in accordance with D1.2 "Structural Welding Code - Aluminum" and D1.3 "Structural Welding Code - Sheet Steel."

1. Certify that each welder employed in unit of work of this section has satisfactorily passed American Welding Society (AWS) qualification tests for welding processes involved and, if pertinent, has undergone recertification.
2. Testing for recertification is Contractor's responsibility.

D. **Engineer Qualifications.** Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated which has resulted in the successful installation of louvers similar in material, design, and extent to that indicated for this project.

E. **Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Standard.** Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

F. **Underwriters' Laboratories, Inc. (UL) and National Electrical Manufacturers Association (NEMA) Compliance.** Provide motors and related components for motor operated adjustable louvers which are listed and labeled by UL and comply with applicable NEMA standards.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Product data for each product** indicated.

C. **Shop Drawings of Louver Units and Accessories**. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; and profiles of frames at jambs, heads and sills.

1. Where installed products are indicated to comply with certain structural design loadings, include structural computations, material properties, and other information needed for structural analysis which has been prepared by, or under the supervision of, a qualified professional engineer.

D. **Wiring diagrams detailing wiring** for power and control systems; differentiating clearly between manufacturer-installed wiring and field-installed wiring.

E. **Samples for initial selection purposes** in form of manufacturer's color charts showing full range of colors available for those units with factory applied color finishes.

F. **Samples for verification purposes** of each type of metal finish required, prepared on 6 inch square metal samples of same thickness and alloy indicated for final unit of work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

G. **Product test reports** evidencing compliance of units with performance requirements indicated.

H. **Product certificates signed by louver manufacturers** certifying that their products which comply with project requirements are licensed to bear Air Movement and Control Association (AMCA) Seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.

I. **Qualification data for firms and persons** specified in "Quality Assurance" article to demonstrate their capabilities and experience.

1.5 JOB CONDITIONS

A. **Field Measurements.** Check actual louver openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

1.8 DEFINITIONS

A. **Louver Terminology.** Refer to Air Movement and Control Association (AMCA) Publication 501-85 for definitions of terms for metal louvers not otherwise defined in this section or referenced standards.

1.9 SYSTEM PERFORMANCE REQUIREMENTS

A. **Structural Performance.** Design, engineer, fabricate, and install exterior metal wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors:

1. Wind Load. Uniform pressure (velocity pressure) of 20 pounds per foot (lbf) per square foot (psf) acting inwards or outwards.

2. Wind Load. Uniform pressures (velocity pressures) indicated on drawings, acting inwards or outwards.

3. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss.

   a. Temperature Change (Range). 100 degrees Fahrenheit (° F.) (55.5 degrees Celsius [° C.]).

B. **Air Performance, Water Penetration, and Air Leakage Ratings.** Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturers stock units, of height and width indicated, according to AMCA Standard 500.

C. **Airborne Sound Transmission Loss.** Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturer's stock units according to American Society for Testing and Materials (ASTM) E 90.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Louvers.

   a. Airline Products Co. Div., Danzer Metal Works Co.
   b. Airolite Co.
   c. Airstream Products Div., Penn Ventilator Co., Inc.
   d. American Warming and Ventilating, Inc.
   e. Arrow United Industries.
   f. Construction Specialties, Inc.
   g. Industrial Louvers, Inc.
   h. Reliable Metal Products.
   i. Ruskin Mfg. Div., Phillips Industries, Inc.

2. Metal Wall Vents.

   a. Airline Products Co. Div., Danzer Metal Works Co.
   b. Airolite Co.
   c. Airstream Products Div., Penn Ventilator Co., Inc.
   d. Arrow United Industries.
   e. Construction Specialties, Inc.
   f. Industrial Louvers, Inc.
   g. Riesner Vent Brick Corp.
   h. Reliable Metal Products.
   i. Ruskin Mfg. Div., Phillips Industries, Inc.
   j. Sunvent Industries, Sylro Sales Corp.

2.2 MATERIALS

A. **Galvanized Steel Sheet.** ASTM A 526 or A 527, G90 zinc coating, mill phosphatized.

B. **Aluminum Sheet.** ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer to produce required finish.

C. **Aluminum Extrusions.** ASTM B 221, Alloy 6063-T5 or T-52.

D. **Fasteners.** Of same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

1. Use types, gauges, and lengths to suit unit installation conditions.
2. Use Phillips flat head machine screws for exposed fasteners, unless otherwise indicated.

E. **Anchors and Inserts.** Of type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

F. **Bituminous Paint.** SSPC-Paint 12 (cold applied asphalt mastic).

G. **Galvanizing Repair Paint.** High zinc dust content paint for re-galvanizing welds in galvanized steel, complying with SSPC-Paint-20.

2.3 FABRICATION, GENERAL

A. **General.** Fabricate louvers and vents to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

B. **Preassemble louvers in shop** to minimize field-splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. **Maintain equal louver blade spacing**, including separation between blades and frames at head and sill, to produce uniform appearance.

D. **Fabricate frames**, **including integral sills**, to fit in openings of size indicated with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.

E. **Include supports, anchorages, and accessories** required for complete assembly.

F. **Provide vertical mullions** of type and at spacing indicated but not further apart than recommended by manufacturer, or 72 inches on center (o.c.), whichever is less. At horizontal joints between louver units provide horizontal mullions except where continuous vertical assemblies are indicated.

G. **Provide sill extensions and loose sills** made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

H. **Join frame members to one another** and to fixed louver blades as follows, unless otherwise indicated, or size of louver assembly makes bolted connections between frame members necessary:

1. With fillet welds, concealed from view.
2. With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with louver manufacturer.

2.4 FIXED EXTRUDED-ALUMINUM WALL LOUVERS

A. **Horizontal Drainable Fixed-Blade Louvers.** Extruded-aluminum frames and louver blades; designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and of channels in jambs and mullions; complying with the following requirements.

1. Louver Depth. 6 inches, unless otherwise indicated.

2. Frame Thickness. 0.125 inch, unless otherwise indicated.

3. Louver Blade Thickness. 0.125 inch, unless otherwise indicated.

4. Louver Blade Angle. 45 degrees, unless otherwise indicated.

5. Performance Requirements. As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

   a. Louver Free Area. Not less than 7.34 square feet (sf).
   b. Static Pressure Loss. Not more than 0.15 inch water gauge at an airflow of 1,000 feet per minute (fpm) free area intake velocity.
   c. Water Penetration. Not more than 0.02 ounces psf of free area at an airflow of 1,450 fpm free area velocity when tested for 15 minutes.

6. AMCA Seal. Mark units with AMCA Certified Ratings Seal.

B. **Horizontal Drainable Sightproof Fixed-Blade Louvers.** Extruded-aluminum frames and sightproof louver blades; designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and of channels in jambs and mullions; complying with the following requirements:

1. Louver Depth. 5 inches.

2. Frame Type. Channel flange.

3. Frame Thickness. 0.081 inch.

4. Louver Blade Thickness. 0.081 inch.

5. Louver Blade Profile. As indicated.

6. Louver Blade Spacing. 2 inches o. c.

7. Performance Requirements. As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

   a. Louver Free Area. Not less than 8.42 sf.
   b. Static Pressure Loss. Not more than 0.15 inch water gauge at an airflow of 750 fpm free area intake velocity.
   c. Water Penetration. Not more than 0.02 ounce psf of free area at an airflow of 760 fpm free area velocity when tested for 15 minutes.

8. AMCA Seal. Mark units with AMCA Certified Ratings Seal.

9. Product. Subject to compliance with requirements, provide Model K605 manufactured by Airolite Co.

C. **Horizontal Nondrainable Fixed-Blade Louvers.** Extruded-aluminum frames and louver blades, complying with the following requirements:

1. Louver Depth. 6 inches, unless otherwise indicated.

2. Frame Type. Channel flange, unless otherwise indicated.

3. Frame Thickness. 0.081 inch, unless otherwise indicated.

4. Louver Blade Thickness. 0.081 inch, unless otherwise indicated.

5. Louver Blade Profile. As indicated.

6. Louver Blade Angle. 45 degrees, unless otherwise indicated.

7. Performance Requirements. As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

   a. Louver Free Area. Not less than 6.67 sf.
   b. Static Pressure Loss. Not more than 0.15 inch water gauge at an airflow of 810 fpm free area intake velocity.
   c. Water Penetration. Not more than 0.02 ounce psf of free area at an airflow of 855 fpm free area velocity when tested for 15 minutes.

8. AMCA Seal. Mark units with AMCA Certified Ratings Seal.

D. **Continuous Horizontal Fixed-Blade Louvers.** Extruded-aluminum frames and louver blades with supporting framework concealed from view from outside face of louver by placing braces, mullions, and brackets on inside face; with close fitting, field made splice joints in blades designed to permit expansion and

contraction without deforming blades or framework; and complying with the following requirements:

1. Louver Depth. 6 inches, unless otherwise indicated.
2. Frame Type. Channel flange.
3. Frame Thickness. 0.081 inch, unless otherwise indicated.
4. Louver Blade Thickness. 0.081 inch, unless otherwise indicated.
5. Louver Blade Profile. As indicated.
6. Louver Blade Angle. 45 degrees, unless otherwise indicated.
7. Louver Blade Spacing. 6 inches o.c. for 6 inch deep, 45 degree angle louver blades.
8. Louver Free Area. Not less than 6.83 sf 48-inch-wide-by-48-inch-high section.
9. Exterior Corners. Prefabricated corner units with mitered and welded blades aligned with straight sections, with concealed bracing.

E. **Vertical Sightproof Fixed-Blade Louvers.** Extruded-aluminum frames and vertical sightproof louver blades complying with the following requirements.

1. Louver Depth. As indicated.
2. Frame Type. Channel flange.
3. Frame Thickness. 0.081 inch.
4. Louver Blade Thickness. 0.081 inch.
5. Louver Blade Profile. As indicated.
6. Louver Blade Spacing. As indicated.
7. Louver Free Area. As indicated.

2.5 FIXED FORMED SHEET METAL WALL LOUVERS

A. **Horizontal Drainable Fixed-Blade Louvers.** Frames and louver blades fabricated from metal of kind and in form indicated below; designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and of channels in jambs and mullions; complying with the following requirements:

1. Louver Blade Metal and Thickness. Galvanized steel sheet, 0.0635 inch (16 gauge), unless otherwise indicated.

2. Louver Blade Metal and Thickness. Galvanized steel sheet, 0.0516 inch (18 gauge), unless otherwise indicated.

3. Louver Blade Metal and Thickness. Aluminum sheet, 0.040 inch, unless otherwise indicated.

4. Louver Blade Metal and Thickness. As indicated.

5. Frame Metal and Thickness. Same as louver blades, unless otherwise indicated.

6. Louver Depth. 6 inches, unless otherwise indicated.

7. Louver Blade Angle. 45 degrees, unless otherwise indicated.

8. Performance Requirements. As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

   a. Louver Free Area. Not less than 7.61 sf.
   b. Static Pressure Loss. Not more than 0.15 inch water gauge at an airflow of 960 fpm free area intake velocity.
   c. Water Penetration. Not more than 0.02 ounce psf of free area at an airflow of 1,100 fpm free area velocity when tested for 15 minutes.

9. AMCA Seal. Mark units with AMCA Certified Ratings Seal.

B. **Horizontal Nondrainable Fixed-Blade Louvers.** Frames and louver blades fabricated from metal of kind and in form indicated below; complying with the following requirements:

1. Louver Blade Metal and Thickness. As indicated.

2. Frame Metal and Thickness. Same as louver blades, unless otherwise indicated.

3. Louver Depth. 6 inches, unless otherwise indicated.

4. Frame Type. Channel flange, unless otherwise indicated.

   a. Continuous Vertical Assemblies. Where height of louver units exceed fabrication and handling limitations, fabricate units to permit field bolted assembly with blade pattern uninterrupted in vertical spacing with close fitting joints in jamb frames, reinforced with splice plates.

5. Louver Blade Profile. As indicated.

6. Louver Blade Angle. 45 degrees, unless otherwise indicated.

7. Performance Requirements. As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

   a. Louver Free Area. Not less than 5.88 sf.
   b. Static Pressure Loss. Not more than 0.15 inch water gauge at an airflow of 960 fpm free area intake velocity.
   c. Water Penetration. Not more than 0.02 ounce psf of free area at an airflow of 800 fpm free area velocity when tested for 15 minutes.

8. AMCA Seal. Mark units with AMCA Certified Ratings Seal.

2.6 ADJUSTABLE EXTRUDED-ALUMINUM WALL LOUVERS

A. **General.** Provide adjustable blade louvers with manufacturer's recommended bearings and operating mechanisms to suit louver sizes and actuator indicated below:

1. Hand operation with push bars.

2. Hand operation with spring, chain, wall bracket, and 160 degrees Fahrenheit (° F.) (71 degrees Celsius [° C.]) fusible link.

3. Crank operation, with removable crank operator in sill or jamb.

4. Chain operation, with tension spring, wall clip, pull chain and 160° F. (71° C.) fusible link.

5. Motor operation, with two directional, 110 volt alternating current (Vac), 60 cycle motor, and limit switches wired for grounding, equipped as follows:
   a. Loose toggle switch and indicator light, ready for installation.

B. **Single-Frame Combination Drainable Fixed/Adjustable Louvers.** Drainable fixed blades and adjustable blades combined in single frame; with both blades and frames fabricated from aluminum extrusions; designed to collect and drain water to exterior at sill by means of gutters in front edges of fixed blades and of channels in jambs and mullions; complying with following requirements:

1. Louver Depth. 6 inches, unless otherwise indicated.

2. Frame Thickness. 0.125 inch, unless otherwise indicated.

3. Fixed Louver Blade Thickness. 0.081 inch, unless otherwise indicated.

4. Adjustable Louver Blade Thickness. 0.125 inch, unless otherwise indicated.

5. Louver Blade Angle. 45 degrees, unless otherwise indicated.

6. Performance Requirements. As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

   a. Louver Free Area. Not less than 7.22 sf.
   b. Air Leakage. Not more than 3.5 cubic feet per minute (cfm) psf of louver gross area at a differential static pressure of 0.15 inch water gauge with adjustable louver blades closed.
   c. Static Pressure Loss. Not more than 0.15 inch water gauge at an airflow of 980 fpm free area intake velocity.
   d. Water Penetration. Not more than 0.02 ounce psf of free area at an airflow of 950 fpm free area velocity when tested for 15 minutes.

7. AMCA Seal. Mark units with AMCA Certified Ratings Seal.

C. **Drainable Adjustable-Blade Louvers.** Extruded-aluminum frames and louver blades; designed to collect and drain water to exterior at sill by means of gutters in front edges of adjustable blades and of channels in jambs and mullions; complying with the following requirements:

1. Louver Depth. 6 inches, unless otherwise indicated.

2. Frame Thickness. 0.125 inch, unless otherwise indicated.

3. Louver Blade Thickness. 0.125 inch, unless otherwise indicated.

4. Louver Blade Angle. 45 degrees, unless otherwise indicated.

5. Accessories. Equip louvers as follows:

   a. Snap on blade edge gaskets for each louver blade to produce continuous air tight closures.

   b. Metal jamb seals between adjustable louver blade ends and jambs to restrict air leakage fabricated from the following:

      1) Stainless steel, American Iron and Steel Institute (AISI) Type 301, with No. 2B finish.

6. Performance Requirements. As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

   a. Louver Free Area. Not less than 7.22 sf.
   b. Air Leakage. Not more than 3.5 cfm psf of louver gross area at a differential static pressure of 0.15 inch water gauge with adjustable louver blades closed.
   c. Static Pressure Loss. Not more than 0.15 inch water gauge at an airflow of 980 fpm free area intake velocity.
   d. Water Penetration. Not more than 0.02 ounce psf of free area at an airflow of 980 fpm free area velocity when tested for 15 minutes.

7. AMCA Seal. Mark units with AMCA Certified Ratings Seal.

D. **Nondrainable Adjustable-Blade Louvers.** Extruded aluminum frames and louver blades complying with the following requirements:

1. Louver Depth. 6 inches, unless otherwise indicated.
2. Frame Type. Channel flange, unless otherwise indicated.
3. Frame Thickness. 0.125 inch, unless otherwise indicated.
4. Louver Blade Thickness. 0.125 inch, unless otherwise indicated.
5. Louver Blade Profile. As indicated.
6. Louver Blade Angle. 45 degrees, unless otherwise indicated.
7. Louver Blade Spacing. As indicated.
8. Louver Free Area. Not less than 6.83 sf for 48 inch wide by 48 inch high section.

2.7 FIXED ACOUSTICAL WALL LOUVERS

A. **Fixed Extruded-Aluminum Wall Louvers.** Extruded-aluminum louver blades and frames filled on interior with mineral fiber rigid board acoustical insulation

that is retained by perforated aluminum sheet; and complying with the following requirements:

1. Louver Depth. 8 inches, unless otherwise indicated.

2. Frame Thickness. 0.125 inch, unless otherwise indicated.

3. Louver Blade Thickness. 0.125 inch, unless otherwise indicated.

4. Louver Blade Angle. 45 degrees, unless otherwise indicated.

5. Louver Blade Spacing. 8 inches for 8 inch deep louvers.

6. Louver Blade Spacing. As indicated.

7. Louver Free Area. 4.07 sf for 48 inch wide by 48 inch high unit.

8. Airborne sound transmission loss rated as follows per ASTM E 413 as follows, determined by testing per ASTM E 90:

    a. Sound Transmission Class (STC) Rating. 10.

2.8 LOUVER SCREENS

A. **General.** Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Adjustable Louvers. Exterior face, unless otherwise indicated.
2. Screening Type. Bird screening, unless otherwise indicated.

3. Screening Type. Insect screening where indicated.

B. **Secure screens to louver frames** with stainless steel machine screws, spaced at each corner and at 12 inch o.c. between.

C. **Louver Screen Frames.** Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

1. Metal. Same kind and form of metal as indicated for louver frames to which screens are attached.

    a. Reinforce extruded aluminum screen frames at corners with clips.

2. Finish. Same finish as louver frames to which louver screens are attached.

3. Type. Rewireable frames with a driven spline or insert for securing screen mesh.

D. **Louver Screening for Aluminum Louvers.** Fit aluminum louver screen frames with screening covering louver openings and complying with the following requirements:

1. Bird Screening. 1/2-inch-square mesh formed with 0.063-inch-diameter aluminum wire.
2. Insect Screening. 18 x 16 mesh formed with 0.012-inch-diameter aluminum wire.

E. **Louver Screening for Galvanized Steel Louvers.** Fit galvanized steel louver screen frames with screening complying with the following requirements:

**********{BEG COMMENT}
RETAIN ONE REQUIREMENT FROM CHOICES BELOW.
**********{END COMMENT}

1. Bird Screening. 1/2-inch-square mesh formed with 0.063-inch-diameter galvanized steel wire.
2. Insect Screening. 18 x 14 mesh formed with 0.011-inch-diameter galvanized steel wire.

2.9 BLANK OFF PANELS

A. **General.** Fabricate blank off panels from materials and to sizes indicated and to comply with the following requirements:

1. Finish. Match finish applied to louvers with respect to coating type, color and gloss.

2. Attach blank off panels to back of louver frames with stainless steel sheet metal screws.

B. **Non-insulated Blank Off Panels.** Metal sheet complying with the following requirements:

1. Aluminum sheet for aluminum louvers, thickness as follows:

   a. 0.051 inch, unless otherwise indicated.

2. Galvanized steel sheet for galvanized steel louvers, thickness as follows:

   a. 0.051 inch, unless otherwise indicated.

C. **Insulated Blank Off Panels.** Laminated metal faced panels consisting of insulating core surfaced on back and front with metal sheets; complying with the following requirements:

1. Thickness. 1 inch.
2. Metal Facing Sheets. Aluminum sheet, 0.032 inch thick.
3. Insulating Core. Unfaced rigid glass fiber board insulation complying with ASTM C 612, Class 1 and 2.

4. Edge Treatment. Trim perimeter edges of blank off panels with louver manufacturer's standard extruded aluminum channel frames 0.081 inch thick, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with polyvinyl chloride compression gaskets, 1/8 inch by l inch.

2.10 WALL VENTS

A. **Extruded-Aluminum Wall Vents.** Extruded-aluminum louvers and frames not less than 0.125 inch thick and assembled by welding; with 18 x 14 mesh aluminum wire insect screening on inside face; incorporating weep holes, continuous drip at sill, and integral water stop on inside edge of sill; of load bearing design and construction.

2.11 FINISHES, GENERAL

A. **Comply with National Association of Architectural Metal Manufacturers** (NAAMM) "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. **Finish louvers after assembly**.

2.12 ALUMINUM FINISHES

A. **Finish designations prefixed by "AA"** conform to the system established by the Aluminum Association for designating aluminum finishes.

B. **Class II Clear Anodized Finish.** AA-M12C22A31 (Mechanical Finish: as fabricated, non-specular; Chemical Finish: etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

C. **Class I Clear Anodized Finish.** AA-M12C22A41 (Mechanical Finish: as fabricated, non-specular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural: clear film thicker than 0.7 mil) complying with AAMA 607.1.

D. **Conversion Coated Finish.** AA-C12C42 (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate fluoride phosphate pretreatment).

1. Organic Coating. Air dried zinc chromate primer with not less than 2.0 mils dry film thickness.

E. **Class I Color Anodized Finish.** AA-M12C22A42/A44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, Medium Matte; Anodic Coating: Class II Architectural, film thicker than 0.7 mil with integral color or electrolytically deposited color) complying with AAMA 606.1 or AAMA 608.1.

1. Color. As selected by Engineer/Architect from within standard industry colors and color density range.

F. **Baked Enamel Finish.** AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid

chromate fluoride phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.

1. Organic Coating. Thermosetting modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with minimum dry film thickness of 1.5 mils, medium gloss.
2. Color. As selected by Engineer/Architect from manufacturer's standard colors.

G. **High-Performance Organic Coating.** AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate fluoride phosphate pretreatment; Organic Coating: as specified below) Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.

1. Fluorocarbon Two-Coat Coating System. Manufacturer's standard two-coat thermocured system, composed of specially formulated inhibitive primer and fluorocarbon color topcoat containing not less than 70 percent polyvinyldene resin by weight; complying with AAMA 605.2.
   a. Color and Gloss. As selected by Engineer/Architect from manufacturer's standard choices for color and gloss.

2.13 GALVANIZED STEEL SHEET FINISHES

A. **Surface Preparation.** Clean surfaces of dirt, grease, and other contaminants followed by a conversion coating of type suited to organic coating applied over it. Clean welds, mechanical connections, and abraded areas followed by application of galvanizing repair paint to comply with ASTM A 780.

B. **Factory-Priming for Field-Painting.** Where field-painting after installation is indicated, apply air dried primer immediately following cleaning and pretreatment.

C. **Baked Enamel Finish.** Immediately after cleaning and pretreatment, apply manufacturer's standard two-coat baked-enamel finish consisting of epoxy prime coat and thermosetting alkyd melamine resin topcoat, with not less than 1.0 mils dry film thickness for topcoat.

D. **High-Performance Organic Coating.** Immediately after cleaning and pretreatment, apply organic coating specified below to comply with coating and resin manufacturer's instructions.

1. Fluorocarbon Two-Coat Coating System. Manufacturer's standard two-coat thermocured system, composed of specially formulated inhibitive primer and fluorocarbon color topcoat containing not less than 70 percent polyvinyldene resin by weight.

   a. Color and Gloss. As selected by Engineer/Architect from manufacturer's standard choices for color and gloss.

PART 3 - EXECUTION

3.1 PREPARATION

A. **Coordinate setting drawings, diagrams**, templates, instructions, and directions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION

A. **Locate and place louver units** plumb, level, and in proper alignment with adjacent work.

B. **Use concealed anchorages** where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. **Form closely fitted joints** with exposed connections accurately located and secured.

D. **Provide perimeter reveals and openings** of uniform width for sealants and joint fillers, as indicated.

E. **Repair finishes damaged by cutting**, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

F. **Protect galvanized and nonferrous metal surfaces** from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry, or dissimilar metals.

G. **Install concealed gaskets**, flashings, joint fillers, and insulation, as louver installation progresses where required to make louver joints weathertight. Comply with Division 7 section "Joint Sealers" for sealants applied during installation of louver.

3.3 ADJUSTING AND PROTECTION

A. **Protect louvers and vents** from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.

B. **Restore louvers and vents** damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by Engineer/Architect, remove damaged units and replace with new units.

1. Clean and touch up minor abrasions in finishes with air dried coating that matches color and gloss of, and is compatible with, factory applied finish coating.

C. **Test operation of adjustable wall louvers** and adjust as needed to produce fully functioning units which comply with requirements.

3.4 CLEANING

A. **Periodically clean exposed surfaces** of louvers and vents, which are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.

B. **Before final inspection**, clean exposed surfaces with water and with a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

END OF SECTION

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SECTION 09 29 00

GYPSUM DRYWALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install metal support systems and gypsum drywall finish systems in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. All material, testing, and workmanship shall be in conformance with the following standards as referenced herein:

1. ASTM – American Society for Testing and Materials.

1.4 SUBMITTALS

A. **Product Data**. Furnish manufacturer's published product data for each product specified.

B. **Samples**. Submit the following:

1. Drywall – 4" x 4" x full thickness, one of each type specified.
2. Trim – 6-inch-long section of each shape called for and/or required.
3. Fasteners – One of each type and size.

1.5 PROJECT CONDITIONS

A. **Environmental Conditions**. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

B. **Minimum Room Temperatures**. For gypsum board to framing, maintain not less than 50 degrees Fahrenheit (° F.) (10 degrees Celsius [° C.]) for 48 hours prior to application and continuously thereafter until drying is complete.

C. **Ventilation**. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. **Storage**. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. **Handling**. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **STEEL FRAMING FOR CEILINGS**

A. **Steel Studs and Runners**. ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch-minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:

1. Thickness. 0.0329 inch unless otherwise indicated on the drawings.
2. Depth. 6 inches, unless otherwise indicated on the drawings.
3. Galvanized.

B. **Fasteners**. Fasteners shall be of type, size, corrosion resistance material, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved, complying with the recommendations of gypsum drywall manufacturers for applications indicated.

2.2 **GYPSUM BOARD**

A. **General**. Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end joints.

1. Thickness. Provide gypsum board in thicknesses indicated, or if not otherwise indicated, in 5/8-inch thicknesses to comply with ASTM C 840 for application system and support spacing indicated.

B. **Gypsum Wallboard**

1. Type. Moisture resistant.
2. Edges. Tapered and featured (rounded or beveled) for prefilling.

2.3 TRIM ACCESSORIES

A. **Corner Bead and Edge Trim for Interior Installation**. Corner beads, edge trim, and control joints shall comply with ASTM C 1047 and requirements indicated below:

1. Material. Formed metal complying with the following requirement:

   a. Sheet steel coated with zinc by hot dip or electrolytic processes, or with aluminum.

2. Edge trim shapes indicated below by reference to designations of Figure 1 in ASTM C 1047:

   a. "LC" bead, unless otherwise indicated.
   b. "LK" bead with square nose for use with kerfed jambs.
   c. "U" bead where indicated.

3. One Piece Control Joint. Formed with V-shaped slot per Figure 1 in ASTM C 1047, with slot opening covered with removable strip.

2.4 GYPSUM BOARD JOINT TREATMENT MATERIALS

A. **General**. Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

B. **Joint Tape**. Paper reinforcing tape, unless otherwise indicated on the drawings.

1. Use pressure-sensitive or staple-attached open-weave glass-fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.

C. **Setting-Type Joint Compounds**. Factory-prepackaged, job mixed, chemical hardening powder products formulated for uses indicated.

1. Where setting type joint compounds are indicated for use as taping and topping compounds, use formulation for each which develops greatest bond strength and crack resistance and is compatible with other joint compounds applied over it.
2. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.

D. **Drying Type Joint Compounds**. Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use.

1. Ready Mix Formulation. Factory-premixed product.
2. Topping compound formulated for finish (third) coats.
3. All-purpose compound formulated for use as topping compound.

2.5 **MISCELLANEOUS MATERIALS**

A. **General**. Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.

B. **Fastening Adhesive for Metal**. Special adhesive recommended for laminating gypsum boards to steel framing.

C. **Gypsum Board Screws**. ASTM C 1002.

D. **Asphalt Felt**. ASTM D 226, Type I (No. 15).

E. **Sound-Attenuation Blankets**. Unfaced mineral-fiber blanket insulation produced by combining mineral fibers manufactured from glass or slag with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. **General**. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in anchors, and structural framing, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 **INSTALLATION OF STEEL FRAMING, GENERAL**

A. **Steel Framing Installation Standard**. Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

1. Install supplementary framing, blocking, and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook" published by United States Gypsum Company.

3.3 **INSTALLATION OF STEEL FRAMING**

A. **Installation**

1. Install runners (tracks) at structural walls and columns where gypsum drywall stud system abuts other construction.

a. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.

2. Installation Tolerances. Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from plane of faces of adjacent framing.

3. Install steel studs in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.

   a. For single- and double-layer construction. 16 inches on center.

4. Frame openings as required for electrical and mechanical

3.4 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL

A. **Gypsum Board Application and Finishing Standard**. Install and finish gypsum board to comply with ASTM C 840.

1. Locate exposed end butt joints as far from center of walls as possible, and stagger not less than 24 inches in alternate courses of board.

2. Install ceiling boards across framing with no joints, except at walls.

3. Install exposed gypsum board with face side out. Do not install imperfect, damaged, or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

4. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges, and mill cut or field cut ends against mill cut or field cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

5. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flange first.

6. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

7. Form control joints and expansion joints at locations indicated, with space between edges of boards prepared to receive trim accessories.

8. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

3.5 METHODS OF GYPSUM BOARD APPLICATION

A. **Single-Layer Application**. Install gypsum wallboard as follows:

1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.

B. **Fastening Methods**. Apply gypsum boards to steel framing with adhesive and supplementary screws.

3.6 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. **General**. Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fastening flanges shall comply with manufacturer's recommendations.

B. **Edge Trim**. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semiexposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U" bead (semifinishing type) is indicated.

1. Install "LC" bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
2. Install "LK" bead where substrate is kerfed to receive long flange of trim.
3. Install U type trim where edge is exposed, revealed, gasketed, or sealant filled (including expansion joints).

C. **Control Joints**. Install control joints at locations indicated, or if not indicated, at spacings and locations required by referenced gypsum board application and finish standard, and approved by the Engineer/Architect for visual effect.

3.7 FINISHING OF DRYWALL

A. **General**. Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects, and elsewhere as required to prepare work for decoration.

1. Prefill open joints and rounded or beveled edges, if any, using setting type joint compound.

2. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

3. Finish interior gypsum wallboard by applying the following joint compounds in three coats (not including prefill of openings in base), and sand between coats and after last coat (level 5):

   a. Embedding and First Coat. Setting type joint compound.
   b. Fill (Second) Coat. Setting type joint compound.
   c. Finish (Third) Coat. Ready mix drying type all purpose or topping compound.

3.8 **PROTECTION**

A. **Protection**. Provide final protection and maintain conditions, in a manner suitable to installer, which ensures gypsum drywall construction being without damage or deterioration at time of substantial completion.

END OF SECTION

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SECTION 09 30 13

TILE, CERAMIC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install ceramic tile in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in accordance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. All material, testing, and workmanship shall be in conformance with the following standards as referenced herein:

1. ANSI – American National Standards Institute.
2. TCA – Tile Council of America.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's product data on all materials.

B. **Shop Drawings**. Furnish drawings that show sizes, colors, patterns, accessories, method of installation, and finishes.

C. **Samples**

1. Unglazed. Submit 12" x 12" sample for each pattern layout, size, and color.
2. Glazed. Submit two 4" x 4" samples of each color selected and one of each trim piece, such as cove, cap, bullnose, etc.
3. Grout. Submit grout sample for type and color.
4. Adhesive. Submit 1/2 pint of each type of adhesive.

1.5 JOB CONDITIONS

A. **Coordination**. Schedule and coordinate all work to avoid delays, errors, and/or omissions.

B. **Environmental Conditions**. Comply with the referenced standards.

C. **Extra Stock**. An additional 2 percent of each tile color, size, shape, and type from the same batch run shall be supplied to the Owner for future use.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**. Deliver materials in original packages or containers bearing brand name, color, lot number, and identification. Do not deliver tile and accessories until building is under cover. Extra stock shall be delivered at the same time, packed, and clearly marked.

B. **Storage**. Store materials inside and under cover and keep dry. Keep in original containers until used.

C. **Handling**. Handle all material in accordance with the manufacturer's directions.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **TILE**

A. **Unglazed**. Tile shall be fine grained porcelain body with color throughout the tile. Tile shall be stain proof, dent proof, frost proof, virtually impervious with an absorption factor of 1/2 percent.

1. Size. Tile shall be 2" x 2" and 1" x 1" size not less than 1/4 inch thick.
2. Pattern. As selected by the Engineer to match existing.

B. **Slip Resistant**. Same as unglazed with the addition of 7-1/2 percent abrasive by weight.

C. **Glazed**. Glazed tile shall be 4 1/4 x 4 1/4, 5/16 with high gloss, cushion edge, self spacers for 1/16 inch joint. Tile shall have moisture absorption not greater than 16 percent and breaking strength not less than 100 pounds.

D. **Trim**. All trim shall be same material as tile.

2.2 **ADHESIVE**. Epoxy type meeting ANSI A188.

2.3 **GROUT**. Grout shall be epoxy cement as recommended by the TCA. Color shall match tile selected by the Owner.

2.4 **MANUFACTURER**. American Olean Tile Company, Monarch Tile Manufacturing, Summitville Tiles, Inc., or equal.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. **Site Verification of Conditions**. Examine substrates on which ceramic tile is to be installed for compliance with requirements for installation conditions and

tolerances. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 **SURFACE PREPARATION**

A. **Condition**. Surfaces which are to receive tile shall be free of defects, depressions, or other imperfections that can affect bonding and a satisfactory and acceptable installation.

B. **Waterproofing**. Prior to installation of the tile, all walls shall be sealed tight and prime coated as recommended by the adhesive manufacturer.

3.3 **INSTALLATION**

A. **Bedding**. Tile shall be installed by the thin bed method.

B. **Layout.** Tile shall be carefully centered to avoid cuts to no less than one half tile size. All joints shall be straight, true, and even width throughout. Tile to be installed level with no less variation than 1/8 inch in 8 feet, unless noted otherwise on the drawings.

C. **Cutting**. Grind all cuts and fit tile close around all pipe, outlets, and fittings; splitting of tile is expressly prohibited. No broken, chipped, or cracked tile will be accepted.

D. **Grouting**. Tile joints shall be grouted solid and uniformly with all excess grout removed.

3.4 **CLEANING**. All tile shall be cleaned and treated with two coats of clear silicone.

END OF SECTION

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SECTION 09 30 99

Restoration of Marble, Terrazzo, & Tile Flooring

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. Stone Flooring

1. Maintain and repair as required plywood protection over all existing stone floors installed.

2. Resurface stone floors utilizing a 300-400 grit and seal with water and oil repellent sealer.

3. Repair stone floors with polyester resin as required. Repairs include holes drilled thru stone, damage where demolished partitions were removed, and chips/cracks.

B. Terrazzo Flooring

1. Maintain and repair as required plywood protection over all existing terrazzo floors installed during the soft demolition phase.

2. Resurface terrazzo flooring and border strips with a 300-400 grit and seal with water and oil repellent sealer.

3. Repair terrazzo floor where it is chipped or damaged to match original.

C. Tile Flooring

1. Replace broken and damaged tile with new tile to match existing.

D. Clean existing flooring.

1.3 QUALITY ASSURANCE

A. Restoration Specialist: Firm having minimum 5-years experience in comparable restoration Projects, employing personnel skilled in the restoration and operations specified.

B. Field Constructed Mock-Up: Prior to start of work, prepare a cleaning and restoration mock-up of each required floor surface where directed by the Owner. Demonstrate cleaning and restoration materials and methods proposed for use. Obtain Owner approval of visual qualities before proceeding with the work.

1.4 SUBMITTALS

A. Product Data: Manufacturer's technical data for each product to be used, including recommendations for application and use.

B. Cleaning and Restoration Program: Written program for each phase of cleaning and restoration including protection of surrounding materials during work.

1. Describe materials, methods and equipment to be used for each phase of work.

2. If alternative methods and materials are proposed, furnish written description, including documentation of successful use on other comparable Projects.

1.5 JOB CONDITIONS

A. Protect surrounding surfaces from damage resulting from the work.

B. Prevent grout and mortar from staining face of surrounding surfaces. Remove grout and mortar immediately from exposed surfaces.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original and unopened containers and packaging, bearing labels indicating type and names of products and manufacturers.

B. Protect materials during storage and construction from wetting by rain or ground water, and from staining or intermixture with earth and other types of materials.

C. Protect grout, mortar and other materials from deterioration by moisture and temperature.

1. Store in a dry location or in waterproof containers.

2. Keep containers tightly closed and away from open flames.

3. Comply with manufacturer's recommendations for storage temperature requirements.

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter.

B. Brushes: Fiber bristles.

C. Sealer: Mira Seal or approved equal water and oil repellent sealer recommended for use on stone of the type required.

D. Polyester Repair Resin: Akami Marble Repair Compound or approved equal.

PART 3 EXECUTION

3.1 RESTORATION OF EXISTING MARBLE, TERRAZZO AND TILE FLOORS

A. Preservation and Maintenance:

1. Cleaning Methods:

a. Cleaning shall begin with the gentlest means possible.

b. Cleaning and stain-removal products shall be tested on a small, inconspicuous area before using.

c. Do not use abrasive cleaners or mechanical equipment on stone and tile floors.

d. Do not use acid-based cleaning solutions on stone and tile floors because they can damage the complex silicates in a glaze. Acid-based cleaner may be needed to remove discoloration or staining

caused by lime or cement mortar, but shall be tested first, used with caution, and applied only to a wetted floor.

e. Pre-wet floor tile before cleaning.

f. Rinse after cleaning.

g. Organic growth, including mold or mildew, shall be eliminated with a dilute solution of household bleach and a neutral household detergent or a dilute (5- to 10-percent) solution of tri-sodium phosphate (TSP). After application, scrub the floor with a natural bristle or nylon brush and rinse with clear water. Do not leave bleach solutions on floor for more than a few minutes since the alkali in the bleach can lead to the formation of a white efflorescent deposit.

2. Protective Coatings: Comply with ADA Guidelines for a static coefficient of friction of 0.6 for level surfaces and 0.8 for ramps. Apply a non-slip sealer or water to stone and tile floors if required.

B. Repair and Replacement:

1. Mortar Joint Repair: Check floor for loose tiles that need to be re-grouted. Carefully remove damaged mortar by hand and wet joints or apply a bonding agent prior to re-grouting. Use a grout that matches the old in color and consistency.

2. Tile Repair: Removing one tile can endanger surrounding tiles so it may be better to preserve and retain an original tile that is only slightly damaged rather than replacing it.

3. Tile Replacement: When an individual tile or a larger portion of a floor is missing or so severely damaged that it cannot be repaired, or if it has become a safety hazard then it shall be replaced. If damage to tiles is the result of more than normal wear and tear, identify the source of the problem and correct before replacing damaged tiles.

4. Selective Replacement:

a. This cautious approach attempts to replace only the most seriously damaged tiles and shall be undertaken when only a small number of tiles are involved. Unless old, matching tiles can be found and reused, replacement requires specially fabricated reproduction tiles. If possible, individual tiles that are damaged may be replaced with matching tiles salvaged from other, less prominent areas of the floor or from other buildings.

b. Replacing a single damaged tile is based on the ability to remove only the deteriorated tile without harming surrounding tiles. Attempts to remove one or several damaged tiles often fail because a hammer and chisel are used. To avoid damaging good tiles, the grout around the damaged tile shall be removed using a grout saw or for joints wider than 3/8-inch, a dry-cutting diamond blade mounted in an angle grinder or circular saw.

c. New reproduction tile may be different in thickness from the existing tile. If the setting bed does not have enough mortar to grip and hold the tile, one new tile laid among the originals will

eventually come loose. If the new and old tiles are different thickness, the setting bed in which the new tiles are laid shall be modified in height as required to create a level finished surface.

5. Sectional Replacement:

   a. Sectional replacement includes removal of a complete section of damaged tile and replacing that section in it's entirety with new reproduction tiles. Original tiles that remain in good condition shall be saved to be reused in other sections where only a few tiles are damaged.

   b. When laying a section of reproduction tiles, use materials and installation methods including expansion joints or flexible expansion material. Comply with recommendations in the Tile Council of America (TCA) "Handbook for Ceramic Tile Installation".

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 **SUMMARY**

A. **This Section includes acoustical panels and exposed suspension systems for ceilings.**

1.3 **DEFINITIONS**

A. **AC:** Articulation Class.

B. **CAC:** Ceiling Attenuation Class.

C. **LR:** Light Reflectance coefficient.

D. **NRC:** Noise Reduction Coefficient.

1.4 **SUBMITTALS**

A. **Product Data:** For each type of product indicated.

B. **Coordination Drawings:** Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members.
2. Method of attaching hangers to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

C. **Samples for Initial Selection:** For components with factory-applied color finishes.

D. **Samples for Verification:** For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.

2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

E. **Product Test Reports:** Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

F. **Research/Evaluation Reports:** For each acoustical panel ceiling and components.

G. **Maintenance Data:** For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. **Acoustical Testing Agency Qualifications:** An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. **Source Limitations:**

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.

C. **Fire-Test-Response Characteristics:** Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver acoustical panels, suspension** system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. **Before installing acoustical panels,** permit them to reach room temperature and a stabilized moisture content.

C. **Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.**

1.7 PROJECT CONDITIONS

A. **Environmental Limitations:** Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and

ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

A. **Coordinate layout and installation** of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

A. **Furnish extra materials described** below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. **Acoustical Panel Standard:** Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

B. **Acoustical Panel Colors and Patterns:** Match appearance characteristics indicated for each product type.

C. **Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment:** Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (ACT-1 and 2)

A. **Available Manufactures:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. BPB USA
3. Chicago Metallic Corporation
4. Ecophon CertainTeed, Inc.

5. Tectum Inc.
6. USG Interiors, Inc.

B. **ACT-1 Basis-of-Design Product:** Subject to compliance with requirements, provide Armstrong World Industries,: Cirrus Tegular or a comparable product by one of the above:

1. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

    a. Type and Form: Type III, mineral base with painted finish; Form 1, nodular.

    b. Pattern: E (lightly textured)

2. Color: White

3. LR: Not less than 0.85.

4. NRC: Not less than 0.60

5. CAC: Not less than 35.

6. Edge/Joint Detail: Beveled tegular.

7. Thickness: 3/4-inch (15 mm).

8. Modular Size: 24 by 24 inches (610 by 1220 mm).

9. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

C. **ACT-2 Basis-of-Design Product:** Subject to compliance with requirements, provide Armstrong World Industries,: Ceramaguard Fine Fissured or a comparable product by one of the above. Cereramaguard shall be used for all bathrooms, locker rooms, toilets, , and labatory.:

1. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

    a. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.

    b. Pattern: CE (perforated: small holes and lightly textured).

2. Color: White

3. LR: Not less than 0.80.

4. NRC: Not less than 0.55

5. CAC: Not less than 40.

6. Edge/Joint Detail: Square.

7. Thickness: 5/8 inch (15 mm).

8. Modular Size: 24 by 24 inches (610 by 1220 mm).

D.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. **Metal Suspension System Standard:** Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. **Finishes and Colors, General:** Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. **Attachment Devices:** Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

D. **Wire Hangers, Braces, and Ties:** Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING ACT 1 and 2

A. **Manufactures:** Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.
2. BPB USA
3. Chicago Metallic Corporation
4. Ecophon CertainTeed, Inc.
5. USG Interiors, Inc.

B. **Basis-of-Design Product:** Subject to compliance with requirements, provide Armstrong World Industries; 15/16” AL Prelude Plus at **ACT-1** locations and 15/16” Prelude at **ACT-2** locations or a comparable product by one of the above:

C. **Wide-Face, Capped, Double-Web, Steel Suspension System:** Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.

2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Aluminum cold-rolled sheet.
5. Cap Finish: Painted white

2.5 METAL EDGE MOLDINGS AND TRIM

A. **Available Manufactures:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. BPB USA
3. Chicago Metallic Corporation
4. Fry Reglet Corporation
5. Gordon, Inc.
6. USG Interiors, Inc

B. **Extruded-Aluminum Edge Moldings and Trim:** Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
2. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
3. Conversion-Coated Finish: AA-M12C42 (Chemical Finish: cleaned with inhibited chemicals; acid-chromate-fluoride-phosphate conversion coating).
4. Conversion-Coated and Factory-Primed Finish: AA-M12C42R1x (Chemical Finish: cleaned with inhibited chemicals; acid-chromate-fluoride-phosphate conversion coating; organic coating).

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine substrates, areas, and** conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Measure each ceiling area** and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. **General:** Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. **Suspend ceiling hangers from building's structural members and as follows:**

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. **Install edge moldings and** trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. **Install suspension system runners so they are square and securely interlocked with one another.** Remove and replace dented, bent, or kinked members.

E. **Install acoustical panels with** undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

3.4 FIELD QUALITY CONTROL

A. **Special Inspections: Owner will engage** a qualified special inspector to perform the following special inspections and prepare reports:

1. Suspended ceiling system.
2. Hangers, anchors and fasteners.

B. **Remove and replace acoustical** panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

3.5 CLEANING

A. **Clean exposed surfaces of** acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 65 13

RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install resilient wall base and accessories in accordance with the plans and as specified herein.

B. **This section** includes the following:

1. Resilient wall base.
2. Resilient flooring accessories.
3. Resilient carpet accessories.
4. Resilient stair accessories and flooring.

C. **Related Sections.** The following sections contain requirements that relate to this section:

1. Division 9 section "Resilient Tile Flooring."

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install resilient wall base and accessories in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Single Source Responsibility for Products.** Obtain each type and color of product specified from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work. Manufacturer shall offer a coordinated color selection for resilient products.

C. **Fire Performance Characteristics.** Provide products with the following fire performance characteristics as determined by testing products per American Society for Testing and Materials (ASTM) test method indicated below by Underwriters' Laboratories, Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux. 0.45 watts per square centimeter or more per ASTM E 648.
2. Smoke Density. Less than 450 per ASTM E 662.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for each type of product specified.
2. Samples for initial selection purposes of manufacturer's standard sample sets in form of pieces cut from each type of product specified showing full range of colors and patterns available.

1.5 JOB CONDITIONS

A. **Temperature**. Maintain a minimum temperature of 70º F. (21º C.) in spaces to receive products specified in this section for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55º F. (13º C.).

1. Do not install products until they are at the same temperature as that of the space where they are to be installed.

B. **Installation**. Close spaces to traffic during installation of products specified in this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver products to project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, project identification, and shipping and handling instructions.

B. **Store** products in dry spaces protected from the weather with ambient temperatures maintained between 50 degrees Fahrenheit (º F.) (10 degrees Celsius [º C.]) and 90º F. (32º C.).

1. Move products into spaces where they will be installed at least 48 hours in advance of installation.

1.7 SPECIAL WARRANTY

Not used.

1.8 SEQUENCING AND SCHEDULING

A. **General**. Sequence installing products specified in this section with other construction to minimize possibility of damage and soiling during remainder of construction period.

1.9 **EXTRA MATERIALS**

A. **Delivery.** Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof of each different type and color of resilient wall base installed.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. **Manufacturers.** Subject to compliance with requirements, provide products of one of the following:

1. Manufacturers of Resilient Wall Base and accessories:

Johnson Rubber Co., Inc.
Roppe Rubber Corp.

2.2 **RESILIENT WALL BASE**

A. **Rubber Wall Base.** Products complying with FS SS-W-40, Type I, with matching end stops and preformed or molded corner units, and as follows:

1. Height: 4" and 6"
2. Thickness: 1/8" gage.
3. Style: Standard top-set cove for resilient floors.
4. Style: Straight base without cove for carpet floors (as noted).

2.3 **RESILIENT ACCESSORIES**

A. **Resilient Edge Strips, Reducers, and Transitions**. 1/8" thick, homogenous rubber composition, tapered or bullnose edge, color to match flooring, or as selected by Architect from standard colors available; not less than 1" wide. Profiles appropriate for floor materials.

2.4 **INSTALLATION ACCESSORIES**

A. **Concrete Slab Primer.** Nonstaining type as recommended by flooring manufacturer.

B. **Trowelable Underlayments and Patching Compounds.** Latex modified, portland cement based formulation provided or approved by flooring manufacturer for applications indicated.

C. **Adhesives.** Water resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine** areas where installation of products specified in this section will occur, with installer present, to verify that substrates and conditions are satisfactory for installation and comply with manufacturer's requirements and those specified in this section.

3.2 PREPARATION

A. **General.** Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.

B. **Use trowelable** leveling and patching compounds per manufacturers directions to fill cracks, holes, and depressions in substrates.

C. **Remove coatings**, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy duty wire brush.

D. **Broom** or vacuum clean substrates to be covered immediately before installing products specified in this section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

E. **Apply concrete slab primer**, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.3 INSTALLATION

A. **General.** Install products specified in this section using methods indicated according to manufacturer's installation directions.

B. **Apply resilient wall base** to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
2. Install premolded inside and exterior corners before installing straight pieces.

C. **Place resilient accessories** so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.

3.4 CLEANING AND PROTECTION

A. **Perform the following** operations immediately after completing installation:

1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.
2. Sweep or vacuum floor thoroughly.
3. Do not wash floor until after time period recommended by manufacturer.
4. Damp mop resilient accessories to remove black marks and soil.

B. **Protect** flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by manufacturer of resilient product involved.

1. Apply protective floor polish to resilient accessories that are free from soil, visible adhesive, and surface blemishes.

    a. Use commercially available metal, cross linked, acrylic product acceptable to resilient accessory manufacturer.
    b. Coordinate selection of floor polish with Owner's maintenance service.

C. **Clean** products specified in this section not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of project. Clean products using method recommended by manufacturer.

END OF SECTION

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SECTION 09 66 23

RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes thin-set, epoxy-resin terrazzo flooring and base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer who is a contractor member of NTMA.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.2 EPOXY-RESIN TERRAZZO

A. Epoxy-Resin Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Doyle Dickerson Terrazo, Inc.; Terrazzco EZpour Epoxy.
    b. Key Resin Company; Key Epoxy Terrazzo.
    c. Master Terrazzo Technologies LLC; Morricite.
    d. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
    e. Sherwin Williams Company, General Polymers; Terrazzo 1100.
    f. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.

2. Thickness: 3/8 inch nominal.
3. Mix Color and Pattern: Match existing.

B. Materials:

1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane with fiberglass scrim for substrate-crack preparation and reflective-crack reduction.
2. Primer: Manufacturer's product recommended for substrate and use indicated.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.

    a. Physical Properties without Aggregates:

        1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
        2) Minimum Tensile Strength: 3000 psi (20.7 MPa) per ASTM D 638 for a 2-inch (51-mm) specimen made using a "C" die per ASTM D 412.
        3) Minimum Compressive Strength: 10,000 psi (6.9 MPa) per ASTM D 695, Specimen B cylinder.
        4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.

            a) Distilled water.
            b) Mineral water.
            c) Isopropanol.
            d) Ethanol.

e) 0.025 percent detergent solution.
f) 1.0 percent soap solution.
g) 10 percent sodium hydroxide.
h) 10 percent hydrochloric acid.
i) 30 percent sulfuric acid.
j) 5 percent acetic acid.

b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:

1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch (6.35 mm) per ASTM D 635.
2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C) for temperature range of minus 12 to plus 140 deg F (minus 24 to plus 60 deg C) per ASTM D 696.

4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.

a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
b. 24-Hour Absorption Rate: Less than 0.75 percent.
c. Dust Content: Less than 1.0 percent by weight.

5. Finishing Grout: Resin based.

2.3 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type angle, 1/4 inch (6.4 mm) deep.

1. Material: Aluminum, match existing configuration.
2. Top Width: Match existing.

B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.
3. Nosings for terrazzo stair treads and landings.

2.4 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.

1. Manufacturer’s stand, low VOC adhesive.

B. Strip Anchoring Devices: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and required for secure attachment to substrate.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:

1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

    a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations. Install flexible reinforcing membrane at substrate cracks in areas to receive terrazzo.
    c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.

3.2 EPOXY-RESIN TERRAZZO INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Place according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."

C. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m); noncumulative.

D. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

E. Strip Materials:

1. Divider and Control-Joint Strips:

   a. Locate divider strips to separate new and existing terrazzo, and to match existing divider pattern.
   b. Install control-joint strips back to back directly above concrete-slab control joints.
   c. Install control-joint strips with gap between strips, and install sealant in gap.
   d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as required to provide a complete installation.

F. Repair: Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.3 CLEANING AND PROTECTION

A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENT

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. This section includes surface preparation, painting, and finishing of exposed interior and exterior surfaces. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

1. Per Part 4.1 C, painting shall include disturbed and undisturbed areas. Undisturbed Areas. Paint the following undisturbed surfaces in their entirety.

B. **Definitions**. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.3 QUALITY ASSURANCE

A. **Standards**. Ensure that material and workmanship are in accordance with the following standards as referenced herein:

1. SSPC – The Society for Protective Coatings.
2. Corps of Engineers.
3. NSF – NSF International.
4. ICRI – International Concrete Repair Institute.
5. ASTM – American Society for Testing and Materials.
6. NACE – National Association of Corrosion Engineering.
7. NAPF – National Association of Pipe Fabricators, Inc.

B. **Single Source Responsibility**. Provide primers, coats, and finish coats from the same manufacturer.

C. **Compatibility of Work**

1. Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates.
2. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
3. Notify the Engineer/Architect of problems anticipated using the materials specified.

SUBMITTALS

D. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and this specification section.

E. **Submittal Package No. 1 – Product Data**

1. Product Data.

a. Submit manufacturer's technical information, label analysis, and application instructions for each material proposed for use.
b. List each material and cross-reference the specific coating, finish system, and application.
c. Identify each material by the manufacturer's catalog number and general classification.

F. **Submittal Package No. 2 – Color Charts**

1. Samples. Submit manufacturer's color charts for Owner's use.

1.4 **JOB CONDITIONS**

A. **Environmental Conditions**

1. Climatic.

a. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 40 degrees Fahrenheit (° F.) and 90° F.

b. Apply solvent thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45° F. and 95° F.

c. Do not apply paint:

1) In precipitation or fog of any kind.
2) When the relative humidity exceeds 85 percent.
3) At surface temperatures less than 5° F. above the dew point.
4) To damp or wet surfaces.

d. When approved, continue painting during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

2. Ventilation.

a. Be responsible for maintaining adequate ventilation, temperature, and humidity control in all areas where paint is being applied, drying, or curing.

1) "Adequate" ventilation, temperature, and humidity levels are considered to be those required by regulatory agencies and guidelines, the paint manufacturer's product application data, the requirements of this section, and the Owner's Representative.

B. **Warning Signs**

1. Provide and display prominent warning signs indicating "WARNING - PAINTING AND ABRASIVE BLASTING WORK UNDERWAY" throughout the job site wherever surface preparation or painting operations are being performed.

a. These signs shall be no less than 3' x 3' in size, and placed at clearly visible locations near all points of access by person or vehicle to the work area(s).

C. **Lead Bearing Paint**. Contractor is responsible for providing means to remove paint from steel frames in a manner that complies with the local, state and federal rules and regulations regarding protecting workers and surrounding areas from dust migration while preparing areas for painting in accordance with other sections of this Section 09 90 00 Painting.

C. **Priming and Painting Fireproofing of Exposed Structural Steel.**

1. Painting New Exposed Structural Steel to be Covered by Fireproofing: Contractor is responsible for coordination of shop/prime coat of structural steel that will covered by fireproofing after fabricated and/or erection. A prime coat of paint shall be provided in the shop that is approved by the Fireproofing Manufacturer. Fireproofing shall not be coated until all field installation by trades is complete. Any fireproofing shall be repaired prior to application of paint to protect fireproofing. The primer and top coats shall be compatible with the fireproofing material. All fireproofing will be painted in accordance with the schedule provided for new exposed structural steel provided under this contract that is designated to have fireproofing.

2. Painting Existing Exposed Structural Steel has Fireproofing. All existing exposed structural steel that has previously covered with fireproofing, shall be painted to match new work per paint schedule. Contractor to repair any existing fireproofing that has been disturbed prior to application of new paint to match new work. All paint coatings shall be approved by fireproofing manufacturer for compatibility.

3. Repairs: Prior to painting exposed structural steel that has been fireproofing, the Contractor will repair any fireproofing that is disturbed

or damaged by demolition work, or during installation of new work that disturbs or damages fireproofing on existing structural steel, shall be repaired in accordance with manufacturer recommendations for surface preparation and application of fireproofing to those in areas being repaired. The repaired areas will be primed with suitable primer paint, and a new finish paint applied in accordance with the paint schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver materials to the job site in the manufacturer's original, unopened containers bearing a label from the manufacturer that includes the following:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Federal Specification number, if applicable.
4. Manufacturer's stock number and date of manufacture.
5. Contents by volume, for pigment and vehicle constituents.
6. Thinning and application instructions.
7. Color name and number.
8. Manufacturer's name.

B. **Storage**

1. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45° F.
2. Keep storage area in a clean condition, free of foreign materials and residue.
3. Store clean rags in a metal container with a tight-fitting cover.
4. Remove oily rags and waste daily.

C. **Handling**. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**. Use products of the manufacturers listed in the painting schedule. No "Or Equals" will be considered for this project. Submit any potential substitutes according to the General Conditions.

2.2 **PIPE BANDING TAPE, LABELING, AND DIRECTIONAL ARROWS**

A. **Minimum 2 inches wide**, self-sticking.

B. **Meets ASTM** B 946.

C. **5-mil minimum** thickness.

D. **Label text heights** shall be sized as follows:

Under 3/4"	Arrows only
3/4" to 1-1/4"	1/2"
1-1/2" to 2"	3/4"
2-1/2" to 6"	1-1/4"
8" to 10"	2-1/2"
10" and over	3-1/2"

E. **Approved Manufacturers**

1. W. H. Brady Company.
2. Seton Identification Products.
3. Or equal.

2.3 **THINNERS**. Use only the recommended products of the manufacturer furnishing the paint.

2.4 **COLORS**. All colors not specified will be selected by the Owner. Where multiple coats are specified, shade-tint each coat of paint for visual inspection of the number of coats applied.

2.5 **POTABLE WATER CONTACT**. Coatings in contact with potable water shall meet NSF Standard 61 and shall be listed by NSF.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. **Compliance**

1. Examine substrates and conditions for compliance with paint application requirements.
2. Correct unsatisfactory conditions before painting.
3. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
4. If any surface to be finished cannot be put in proper condition, notify the Engineer/Architect immediately in writing or assume full responsibility for failure to do so and correct any unsatisfactory work.

3.2 PREPARATION

A. General Procedures

1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or protect them before surface preparation and painting.
2. Remove these items if necessary for complete painting of the items and adjacent surfaces.
3. Following completion of painting operations in each space or area, reinstall items by workers skilled in the trades involved.
4. All surfaces must be clean, dry, and free of oil, grease, chalk, and other containments.
5. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet paint.

B. **Surface Preparation**. Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Cementitious Materials. Prepare concrete, concrete masonry block, cement plaster, and mineral fiber reinforced cement panel surfaces to be painted.

    a. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents.

    b. Roughen as required to remove glaze.

    c. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

    d. Use abrasive blast cleaning methods according to SSPC-SP13/NACE 6, ICRI CSP 2-3 to prepare concrete unless an alternate method is approved.

    e. Prepare all concrete surfaces designated chemical resistant per ICRI CSP 3-5 minimum with all bugholes opened and filled with an epoxy surfacer (Paint Code F in the Schedule).

    f. Determine alkalinity and moisture content of surfaces by performing appropriate tests.

        1) If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application.
        2) Do not paint surfaces where moisture content exceeds the manufacturer's recommendations.

3. Wood.

    a. Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required.
    b. Sand surfaces smooth which are exposed to view and remove dust when finished.
    c. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer.
    d. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

4. Ferrous Metals. Clean nongalvanized ferrous metal surfaces; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC-SP1/SP2/SP3.

    a. Blast steel surfaces that will be submerged in accordance with requirements of SSPC Specification SSPC-SP 10, near white blast cleaning. Maintain a minimum 2-mil profile.
    b. Abrasive-blast-clean nonsubmerged steel per SSPC-SP 6, Commercial Blast Cleaning creating a minimum 1.5-mil profile.
    c. Brush off blast cleaned (SSPC-SP 7, Brush-Off Blast Cleaning) epoxy shop-primed surfaces that will be submerged and have not been painted for 60 days or longer before application of the intermediate and finish coats.
    d. Blast ductile iron surfaces in accordance with requirements of NAPF 500 Abrasive Blast Cleaning.
    e. Touch up bare areas and prime coats that have been damaged. Surface preparation shall be the same as the original surface preparation. Touch up with the same primer as the shop coat.
    f. Prime all surfaces blast-cleaned on the same day or before rusting or soiling occurs.

5. Plastic. Clean surface and sand uniformly to resemble 80-100 grit sandpaper.

6. Existing Epoxy Finishes. Thoroughly and uniformly sand or otherwise abrade prior to recoating.

C. **Materials Preparation**. Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application.
3. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
4. Use only thinners approved by the paint manufacturer, and only within recommended limits.

3.3 APPLICATION

A. Requirements

1. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

    a. Paint colors, surface treatments, and finishes are indicated in Part 4 of this section.
    b. Provide finish coats that are compatible with primers used.
    c. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
    d. Grind all 90-degree angles of carbon steel and apply a stripe coat of the specified primer.

B. Special Techniques/Requirements

1. Do not permit spraying unless approved in writing.
2. Ensure that the application, drying time between coats, and mixing are in accordance with the recommendations of the manufacturer.
3. Protect all areas from damage by equipment, materials, spatterings, drippings, and overspray. Take particular care to prevent staining of concrete. Immediately remove all spattering, dripping, and overspray. Paint or repaint any area discolored or stained as directed.
4. Prior to installation, finish-paint all surfaces inaccessible after installation.

3.4 MARKING

A. **Color Coding**. Paint and mark according to function all exposed piping as specified in Part 4 of this section.

B. **Banding**. Band all exposed piping as specified in Part 4 of this section. Space banding as directed, but not greater than 10 feet apart with a minimum of one group of bands between fittings.

C. **Flow Arrows**. Provide arrows indicating flow direction on all exposed piping.

D. **Labeling**. Label all exposed piping with the function of the pipe. Apply labeling on any single run of pipe before any tees or elbows, but not greater than 20 feet on center.

3.5 FIELD QUALITY CONTROL

A. **The Owner reserves the right** to invoke the following test procedure at any time and as often as desired during the period when paint is being applied.

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. If test results show material being used does not comply with the published manufacturer's specifications for that paint system:

   a. Stop painting.
   b. Remove noncomplying paint.
   c. Pay for testing.
   d. Repaint surfaces coated with rejected paint.
   e. Remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible.

B. **The Owner reserves the right** to check the minimum dry mil thickness per coat (MDMTPC) at any time following application. Repaint areas not meeting minimum requirements.

C. **Provide a 10' x 10' mock-up** of each specified system, including surface preparation and finish color. The mock-up may remain as part of the completed project. Proceed with the rest of the paint application when authorized to proceed in writing.

3.6 PROTECTION

A. **Cover**. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage in an acceptable manner by cleaning, repairing or replacing, and repainting.

B. **Signs**

1. Provide "wet paint" signs to protect newly painted finishes.
2. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
3. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
4. Remove all "Wet Paint" signs and other warning signs utilized during installation and curing.

3.7 DEMONSTRATION

A. **Visual**. The Contractor, Owner, and Engineer/Architect will visually review the painting for completion, colors, finish, and uniformity before acceptance by Owner.

PART 4 - SCHEDULE

4.1 GENERAL

A. **Dry Film Thickness Per Coat**. DFT is the acronym for this term in the following schedules. Do not exceed the manufacturer's recommended maximum dry film thickness per coat.

B. **New Work**. Paint all new surfaces according to paragraph 4.2.

C. **Existing Areas**

1. Compatibility Test. Before painting, patch test all areas for compatibility of new paint with existing and notify the Engineer/Architect of any incompatibility.

2. Adhesion Test. Before painting, perform the tests per ASTM D 3359, Methods A and/or B, followed by a report detailing the system tested, their results, and any recommended changes to the specified system.

3. Disturbed Areas.

   a. Paint all surfaces of existing areas disturbed due to tie-ins, closing of openings, cutting new openings, rerouting of pipe, relocating or removal of equipment, and other related work as specified herein.
   b. Color match existing surface and paint to lap existing by not less than 3 inches.

4. Undisturbed Areas. Paint the following undisturbed surfaces in their entirety.

   a. All previously painted surfaces in the plant shall be prepared and painted per this specification. Previously painted surfaces include but are not limited to walls, ceilings, floors, door frames, piping, valves, valves operators, operators, conduit, utility boxes, pumps, equipment, structural steel, miscellaneous metals, and steel handrail.
   b. Appendix II of the specifications includes a summary report of the cursory paint sampling analysis. The intent is to prep and paint all door frames without removal of the existing coating. Contractor shall abide by all local, state and federal requirements for handling and surface preparation of lead containing existing coatings.

D. **Coding and Banding**. When exposed, color code and band the following piping, fittings, and valves with the specified colors:

Material	Tnemec	PPG	Carboline	Sherwin Williams	International	ICI/Devoe
Water						
Raw	Spring Water	Fiberoptics	Blue Ice	Generator Green	Light Blue	Seafoam Breeze
Settled	Aqua Sky	Water Garden	Skyward	Alloy Aqua	Mint Green	Cascading Water
Filtered	Delft Blue	Cavern Ice	Open Sky	Conductor Blue	Sky Blue	Car Blue
Softened	Clear Sky	Cooling Tower	Atomic Blue	Robotic Blue	Mid-Ocean Blue	Light Blue
Finished or Potable	Safety Blue	Safety Blue	Safety Blue	Safety Blue	Safety Blue	Safety Blue
Backwash Supply	Purple Haze	Cyprus Blue	National Blue	Camshaft	Blue	National Blue
Nonpotable	Safety Purple	Safety Purple	Safety Purple	Plumb	Safety Purple	Safety Purple
Wastewater						
Raw	Deep Space	Dark Gray	Machine Gray	Graphite	Aluminum Gray	Machine Gray
Primary	Gray	Light Gray	Gull Gray	ANSI #70 Gray	Light Gray	Haze Gray
Secondary	Light Gray	ASA No. 70	Light Gray	Slate Gray	Gray	Light Gray
Filtered	Slate Gray	Mountain Mist	Sterling Gray	Galvano	Platinum Gray	Mist Gray
Effluent	White	Porcelain White	Safety White	Pure White	Blued White	White on White
Backwash Waste/ Supernatant	Aluminum	Conveyor Gray	Granite Gray	Pallet Tan	Steel Gray	Swordplay
Filter to Waste/Drain	Black	Black Gold	Black	Black	Black	Black
Sludge						
Primary	Clay	Weathered	Basket Weave	Olivine	Dark Ivory Beige	Water Chestnut
WAS	Muley	Marble	Blush	Bolt Brown	Medium Brown	Clay Pot
RAS	Amber Canyon	Desert Brown	Alpaca	Bolt Brown	Cream Tan Brown	Tuscan Tan
Digested	Tiki Wood	Beechnut	Dunes Tan	Modular Tan	Medium Brown	Sand Motif
Thickened	Weathered Bark	Tantone Telegraph	Falcon Brown	Umbra	Bark	Warm Brown
Flammable/Explosive						
Natural and Propane Gas	Safety Red	Safety Red	Safety Red	Safety Red	Safety Red	Safety Red
Liquid Fuel Oil/Diesel	Chilean Red	Caution Red	Tile Red	Deck Red	Red	Oxide Red
Methane/Digester Gas	Safety Orange	Safety Orange	Safety Orange	Safety Orange	Safety Orange	Safety Orange
Odor Control Foul Air	International Orange	Caution Orange	Coppers Smith	Mason Brick	International Orange	Kessy's Bark
Air						
Low Pressure (≤ 90 psi)	Hunter Green	Caution Green	Vernal Green	Cedar Green	Signal Green	Medium Green
High Pressure (> 90 psi)	Safety Green	Safety Green	Safety Green	Rain Forest	Safety Green	Safety Green

Material		All Manufacturers
NEORSD PROCESS PIPING COLOR CODES		
Class	**Substance ID**	**Color Code**
Water	Potable Hot Water Fire Water NPW Water Seal Water Steam	Blue Blue with Red Bands Red Light Blue with Orange Bands Blue with Orange Bands White
Drains	Sump Drains Storm Drains Floor Drains	Light Grey Grey with White Bands Light Grey
Gases and Fuels	Air Natural Gas Fuel Oil Vents Plumbing	Green Orange Orange with Brown Bands Aluminum Aluminum
Process Chemicals	Acid (i..e. Sulfuric Acid, etc.) Chlorine Solution Chlorine Gas Lime Slurry Potassium Permanganate	Orange with Black Bands Safety Yellow with Blue Bands Safety Yellow with No Bands Orange with White Bands Violet
Process Liquids	Sanitary Waste Scum and Grease Centrate Supernatant Sludges Grit Clarifier Drains TCTO & GTO	Dark Grey Brown with Black Bands Cream Black Dark Brown Black with Grey Bands Brown with White Bands Black
Electrical Conduit		Match ceilings and walls. Label all ConduitsNo. per Stds.

4.2 **PAINT SCHEDULE**

Surface Substrate	Surface Location	Immersed or Below Grade	Exterior Only	Interior Only	Exterior / Interior	Required Coats	DFT	Paint Codes
Concrete Block or Masonry • Paint Interior of all new Exposed Concrete Block • Paint all other Masonry Where Noted in the Plans or Specifications	Walls			X		1 Primer/Block Filler 1 Intermediate 1 Finish	12 4 4	A B B
	Walls		X			1 Primer/Block Filler 1 Intermediate 1 Finish	12 6 6	A M M
	Walls, Existing painted					*1 Primer* *1 Intermediate* *1 Finish*	*4* *4* *4*	*B* *B* *B*
Precast Concrete and Cast-in-Place Concrete • Paint the interior of all exposed precast concrete ceilings. • Paint all other Concrete Where Noted in the Plans or Specifications.	Walls and Ceilings			X		1 Primer/ Surfacer 1 Finish	12 4	F B
	Walls and Ceilings		X			1 Primer/ Surfacer 1 Intermediate 1 Finish	12 6 6	F M M
	Walls, Ceilings, and Floors, In Contact with Potable Water	X			X	1 Primer/Surfacer 1 Intermediate 1 Finish	- 4 4	F C C
	Walls, Ceilings, and Floors, In Contact with Nonpotable Water or Sewage	X			X	1 Primer/Surfacer 1 Intermediate 1 Finish	- 10 10	F D D
	Walls and Floors, Chemical Resistant				X	1 Primer/ Surfacer 1 Intermediate 1 Finish	12 9 9	F H H
	Floors			X		1 Primer/ Surfacer 1 Intermediate 1 Finish	12 9 9	F E E

For paint codes see paragraph 4.3 at the end of this Section.

Surface Substrate	Surface Location	Immersed or Below Grade	Exterior Only	Interior Only	Exterior / Interior	Required Coats	DFT	Paint Codes
Ferrous Metal Products • Paint all Miscellaneous Fabrications • Paint all Ferrous Metal Products including Piping, Valves, Fittings, Equipment, and Miscellaneous Metals Installed during Project. • Paint existing Ferrous Metal Products Where Noted in the Plans or Specifications. • Metal Siding, Fascia, and Coping shall be prefinished by the manufacturer. • Paint all exposed galvanized conduit and pipe in painted finished areas. • Paint all damaged and disturbed areas of any galvanized products such as threading or field–welds. • Do not paint stainless steel, aluminum, galvanized steel or similar corrosion resistant materials unless noted otherwise in the drawings or the specifications.	Submerged, In Contact with Potable Water	X			X	1 Shop/Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	C C C C
	Submerged, In Contact with Nonpotable Water or Sewage	X			X	1 Shop/Primer 1 Finish	10 10	D D
	High Temperature(<450 °F)				X	1 Shop/Primer 1 Intermediate 1 Finish	1.6 1 1	J L L
	Very High Temperature (450 °F to 750 °F)				X	1 Shop/Primer 1 Intermediate 1 Finish	1.6 1 1	K K K
	Galvanized Product Touch-ups				X	1 Primer 1 Finish	2 2	P P
	Exterior		X			1 Shop/Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	B B B G
	Interior			X		1 Shop/Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	B B B B

For paint code details, see paragraph 4.3 at the end of this Section.

Surface Substrate	Surface Location	Immersed or Below Grade	Exterior Only	Interior Only	Exterior / Interior	Required Coats	DFT	Paint Codes
Structural Steel • Paint interior Exposed Structural Steel in ***Screen Building and Screenings Rooms*** with primer that is approved by fireproofing manufacturer. Paint all exposed structural steel after installation of fireproofing is complete. • Paint all Structural Steel concealed in walls with shop primer and touch-up after field installation. • Paint all existing exposed structural steel to match new work. • Paint all structural steel that support equipment, platforms, and walkways, but do not provide support of the building.	Exposed Steel in Screen Buildings that will be fireproofed			**X**		1 Primer approved by Fireproofing Mfgr. *Fireproofing by others*	4	Q
	Exposed Structural Steel with Fireproofing (Existing and New Steel)			**X**		1 Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	B B B G
	Concealed Structural Steel embedded in Walls			**X**		1 Shop/Primer 1 Touch Up	4 4	B B
	Existing structural steel that is embedded in walls.			**X**		1 Touch Up	4	B
	Exposed Structural Steel Supports for equipment, platforms, walkways except for galvanized or aluminum or non-ferrous fabrications.				**X**	1 Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	B B B G

Plastic Products • Paint all exposed interior Plastic Pipe, Fittings, and Valves installed in this project or where noted in the plans or specifications.		X			1 Primer 1 Intermediate 1 Finish	4 4 4	B B G
			X		1 Primer 1 Finish	2 3	B B
Wood Products • Paint all exposed Wood installed in this project or where noted in the plans and specifications except for Prefinished, Redwood, or Pressure-Treated Products.				X	1 Primer 1 Intermediate 1 Finish	2 2 2	N O O
Foam Piping Insulation • Paint all Foam Piping Insulation Where Noted in the Plans or Specifications.				X	1 Primer 1 Finish	2 4	N O
Drywall and Plaster • Paint all exposed Drywall and Plaster installed in this project or where noted in the plans or specifications.			X		1 Primer 1 Intermediate 1 Finish	2 4 4	N O O
Pipe Coverings and Pipe Drains	Match walls and ceilings						

For paint code details, see paragraph 4.3 at the end of this Section.

4.3 MANUFACTURERS AND PAINT CODES

Generic Name	Code	Tnemec	PPG	Carboline	ICI/Devoe	Sherwin Williams	International
Cementitious Acrylic or Polyamide Epoxy Block Filler	A	Series 130-6602 Envirofill	Aquapon 97-685 Series	Sanitile 600	Bloxfill 4000 Block Filler	Cement Plex 875	Intercryl 320
Polyamide Epoxy	B	Series N69-H.B. Epoxoline II	Aquapon HB 97-130	Carboguard 893 SG	Devran 224 HS	Macropoxy 646 FC	Intergard 251
Polyamide Epoxy NSF 61 Approved	C	Series N140 Pota-Pox Plus	Aquapon 95-132	Carboguard 561	Bar-Rust 233H	Macropoxy 646 PW	Interseal 670HS
Coal Tar Epoxy/Ultra High Build Epoxy	D	Series 46H-413 Black HB Tneme-Tar	Coal Cat 97-650	Bitumastic 300M	Devtar 5A	Hi-Mil Sher Tar	Interzone 954
Self-Leveling/ Polyamide Epoxy	E	Series 281 Tneme-Glaze	Megaseal SL 99-6680	Sanitile 945	DevFloor 525 with DevFloor 571	Cor-Cote HP	Intergard 345
Filler and Surfacer	F	Series 218 MortarClad	Megaseal CF 99-6672 or -6675	Sanitile 600 TG	DevFloor 574 / Bloxfill 4000	Steel Seam FT 910 or General Polymers 3513	Ceilcote 610 / Corocrete SF
Polyurethane	G	Series 1074 H.B. Endura-Shield II	Pitthane Ultra 95-812	Carbothane 134 HG	Devthane 379	Acrolon 218HS	Interthane 870
Novolac Epoxy	H	Series 282 Tneme-Glaze	Megaseal SC/HSN	Semstone 145	Devran 124	ExpressCote HCR	Ceilcote 2000 w/ Ceilcote 680
Not Used	I						
High Temperature Primer	J	Series 90E-92 Tneme-Zinc	Silicone-Acrylic Red	Carbozinc 11	HT-8	Zinc Clad II	Interzinc 22
High Temperature Silicone (Resists at least 450 °F)	K	Series 39	Speedhide 6-230	Thermaline 4900 R	HT-8	Kem Hi-Temp Heat-Flex 450	Intertherm 875

Generic Name	Code	Tnemec	PPG	Carboline	ICI/Devoe	Sherwin Williams	International
Very High Temperature Silicone (resists at least 1000 °F and requires a bake cure)	L	Series 39	Speedhide 6-220	Thermaline 4700	HT-10 Aluminum	Hi-Temp 1000V	Intertherm 50 Aluminum
Elastomeric Acrylic	M	Series 156/157 Envirocrete	Permacrete 4-110	Flexxide Elastomer	#2200 Decra-Flex Elastomeric	Loxon XP	N/A
Acrylic Primer	N	Series 10-10-99W	Seal Grip 17-921	Carbocrylic 120	Devflex 4020	DTM Primer Finish	Intercryl 520
Acrylic	O	Series 6 Tneme-Cryl	Pitt Tech 90-474	Carbocrylic 3359	Devflex 4208	DTM Acrylic	Intercryl 530
Cold Galvanizing Compound	P	Minimum 95% Zinc. Approved Manufacturers: Rust-Oleum, ZRC, or Chesterton 752, or Sherwin Williams Cold Galvanizing Aerosol.					
Shop applied primer for Structural Steel that will receive fireproofing	Q	Provide special shop prime coat to fabricated structural steel after cleaning and fabrication that is approved by fireproofing manufacturer. Field touch up prior to installation of fireproofing. S**olvent based fireproofing products must be compatible with primer. Contractor to apply minimum 4 mils of flat, low end epoxy primer per schedule, or other primer that is approved by fireproofing manufacturer.**					

END OF SECTION

SECTION 09 96 35

CHEMICAL-RESISTANT COATING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary for surface preparation and to furnish and install the epoxy coating in accordance with the plans and as specified herein at the following locations:

1. The interior surface of the chemical storage containment sumps shall be suitable for the intended chemical exposure to be encountered. Material must be capable to withstand a complete submergence for the following chemicals at ambient temperature without crazing, peeling, blistering, or loss of protection for the concrete substrate. Slight discoloration only is permissible. Submit test data to verify that product conforms to this criterion.

a. Hydrofluosilicic Acid (Fluorosilicic Acid)

1.	Molecular Formula:	H_2SiF_6
2.	Solution Strength:	23% to 25%
3.	Specific Gravity:	1.31 to 1.37
4.	pH:	3.6 to 4.6

b. Sodium Bisulfite

1.	Molecular Formula:	$NAHSO_3$
2.	Solution Strength:	34% to 42%
3.	Specific Gravity:	1.25
4.	pH:	1.5 to 2.0

c. Chlorine Gas

1.	Molecular Formula:	Cl_2
2.	Solution Strength:	100%
3.	Specific Gravity:	Compressed Gas

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Installer's Qualification.** The Installer of work of this section shall have 5 years minimum proven experience in this type of installation and shall have satisfactorily completed three jobs of similar size and type within the last 5 years.

C. **Manufacturer's Material Certification.** The Manufacturer of materials in this Section shall have 5 years minimum proven experience of their materials in similar type applications.

1.4 SUBMITTALS

A. **Product Data.** Submit copies of manufacturer's technical information, including label analysis and application instructions for each material proposed for use.

1. Include surface preparation required for each base coat or prime coat product.

2. Include complete job site mixing and preparation procedures, including straining instructions.

3. Include test data in compliance with Paragraph 1.3 A.

B. **Shop Drawings.** Show areas to be coated, proposed protection procedure, repair data, termination and joints, method of application.

C. Certification. Submit:

1. Installer's Certification of Compliance with Paragraph 1.3 B of this Section.

2. Material Certification of Compliance with Paragraph 1.3 C and 1.7 A of this Section.

1.5 JOB CONDITIONS

A. **Preinstallation Conference**. Hold a pre-installation conference with all parties concerned with the work, its application, protection, and guarantee.

B. **Coordination.** Schedule and coordinate work with other trades to avoid delays, errors, and omissions.

C. **Environmental Conditions.** Do not proceed with epoxy coating until the following conditions are met:

1. All work penetrating or built into the substrate is completed.

2. A minimum of 30 days after concrete has been placed to permit curing of concrete.

3. If substrate and ambient air temperature is less than 50 degrees Fahrenheit or 10 degrees Celsius.

4. The Contractor shall be responsible for maintaining adequate ventilation, temperature, and humidity control in all areas where the epoxy coating is being applied, including application, drying, and curing periods.

5. The Contractor shall provide and display prominent warning signs indicating that the epoxy coating work is being performed. The signs shall be no less than 3’ x 3’ in size and shall be placed at clearly visible locations near all points of access to the work area(s).

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery.** Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color, name, and number.

B. **Storage.** Materials not in use shall be stored in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 50º F. (10º C.). Keep storage area in a clean condition, free of foreign materials and residue. Store clean rags in a metal container with a tight fitting cover.

C. **Handling.** Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 SPECIAL WARRANTY

A. None.

PART 2 PRODUCTS

2.1 MATERIALS

A. Epoxy Coating

1. Prime Coat. A high solids, pigmented epoxy primer and binder resin with good blush resistance and is low in viscosity to promote penetration of the concrete substrate and excellent wetting of mortar aggregate.

a. Properties.

1. Mixing Ratio. 2:1; or as recommended by manufacturer.
2. VOC (EPA Method 24): <50 g/L mixed: 0.41 lbs/gal
3. Viscosity, mixed. 1500 to 3000 centipoise (cps).
4. Adhesion. 300 pounds per square inch concrete failure
5. Compressive Strength. 9,000 pounds per square inch
6. Flammability. Self-extinguishing over concrete
7. Flexural Strength. 6,000 pounds per square inch.
8. Hardness, Shore D. 75/65 per ASTM D 2240 test method
9. Tensile Strength. 3,000 pounds per square inch minimum per ASTM D 638
10. Pot Life. Gallon Mass 25 to 30 minutes @ 73ºF.

2. Finish Coat. A pigmented, high-build, high solids Novalac epoxy which resists vapor, splash, spillage, or immersion to certain aggressive acids, alkalies, and solvents. This epoxy shall bond aggressively to the properly prepared and primed substrates, protecting the substrate from damaging chemicals.

a. Properties.

1. Mixing Ratio. 2:1; or as recommended by manufacturer.
2. VOC (EPA Method 24): <50 g/L mixed: 0.41 lbs/gal
3. Viscosity, mixed. 1,000 centipoise (cps).
4. Adhesion. 300 pounds per square inch concrete failure
5. Abrasion Resistance. 100 mg loss per ASTM D4060 CS17 wheel, 1,000 cycles test method.
6. Flammability. Self-extinguishing over concrete
7. Hardness, Shore D. 80 per ASTM D 2240 test method
8. Resistance to Elevated Temperatures. No slip or flow at required temperature of 158ºF.
9. Pot Life. Gallon Mass 40 minutes @ 73ºF.

3. Spreading Rate.
   a. Prime coat. 6-20 mils or 150-500 microns
   b. Finish coat. 10-20 mils or 250-500 microns
4. Color.
   a. All surfaces shall be coated with alternating color layers.
   b. Finish color shall be selected by Owner.
5. Products/Manufacturers.
   a. Primer Coat: General Polymers GP3579 STANDARD EPOXY PRIMER/ BINDER (PARTS A & B) by Sherwin Williams, or approved equal.
   b. Finish Coat: General Polymers GP 3741 NOVO_FLO SOLVENT/ACID RESITATNT COATING (PARTS A & B)by Sherwin Williams, or approved equal.

B. Chemical-Resistant Coating

1. A high acid resistant, two- or three-component polymer-based 100 percent solids vinyl ester coating. The mixing ratio shall be as recommended by the manufacturer.
2. Minimum dry mil thickness per coat (MDMTPC).

	MDMTPC
Prime Coat	15
Intermediate Coat	15
Finish Coat	15

3. Coloration. Coat all surfaces with alternating color layers. For example, the base coat could be cream, intermediate coat light, and top coat off-white.
4. Products/Manufacturers.
   a. Plasite 4007, Carboline.
   b. Series 120 Vinestra, Tenemec Company, Inc.
   c. Series 8000 CoRezyn, Interplastic Corporation.

C. Miscellaneous Items.

1. Provide primers, fillers, glass granules, sealers, joint tapes, adhesives, and accessories as recommended by the manufacturer of the epoxy coating and chemical resistant coating for the application shown.

2. The drying schedule shall comply with manufacturer's recommendations.

D. Repair Parts.

1. Provide one 0.9 gallon kit for touch-up and repair.

PART 3 EXECUTION

3.1 INSPECTION

A. **Surface Examination**. Contractor shall examine the surface to receive the chemical resistant protective coating and the conditions under which the chemical resistant protective coating work is to be performed, and notify the Engineer/Architect in writing of any conditions detrimental to the proper and timely completion of the work and performance of the coating. Do not proceed with the chemical resistant protective coating work until unsatisfactory conditions have been corrected. Start of chemical resistant coating application will be construed as the applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION OF SUBSTRATE

A. General

1. Surfaces shall be prepared in accordance with Manufacturer's recommendation. A vapor/moisture barrier shall be provided if recommended by the Manufacturer.

2. Surfaces shall be free of dirt, foreign material, and projections.

3. Fill voids, seal joints, and apply bond breakers as recommended by the Manufacturer.

4. Safety. Refer to MSDS sheet befoe use.

5. Prime the substrate as recommended by the Manufacturer.

6. Contractor will clean and remove all residues and:

a. Concrete surfaces should be shot blasted and surface shall be clean and dry. It shall be the Contractor's responsibility to remove materials used to prepare the surfaces for coating. Materials shall be removed off the site for proper disposal. Objects and surfaces not to be coated shall be protected.

b. Glazed tile shall be mechanically roughened per the manufacturer's recommendations and then prepped per 5.a above.

c. Mixing.

1. Premix the individual components so as to redistribute any pigments that may have settled during storage. Mixing the chemical resistant coating shall be as recommended by the manufacturer.

3.3 APPLICATION

A. General

1. Do not allow liquid and mastic compounds to enter drains and pipes. Prevent spillage and migration onto other surfaces of the work.

2. Apply in accordance with manufacturer's recommendations.

3. Walls. Protective coating may be applied by brush or roller. No spray applications will be permitted.

a. Apply a uniform coating to the surfaces indicated. Apply second coat of protective coating after initial "set" of the first application but not longer than 48 hours.

b. Allow at least 7 days cure at between 70 to 75 degrees Fahrenheit. Lower temperatures will require longer cure times.

4. Floors, stair treads, and other varying surfaces.

a. Apply a uniform prime coat to the surfaces indicated and allow to dry to initial set.

b. The intermediate coat should be applied and immediately broadcast with glass granules into the coating at a rate of 100 percent saturation or approximately 0.2 to 0.3 pounds per square foot.

c. The finish coat of protective coating should be applied and broadcast with glass granules at a rate of 100 percent saturation or approximately 0.3 to 0.4 pounds per square foot.

B. **Protection**. Protect work and restrict access to protective coating until coating has reached a complete cure.

3.4 FIELD QUALITY CONTROL

A. **After completion of each coat**, the Contractor shall notify The Engineer/Architect for visual inspection. Proceed with succeeding coats only after inspection and approval of the previous coat by the Engineer/Architect.

3.5 CLEAN UP AND PROTECT

A. **During the progress of the work**, remove from the site all discarded materials, rubbish, cans, and rags at the end of each day.

B. **After final cure**, clean wearing surfaces to remove any excess or loose glass granules.

C. **At the completion of work** of other trades, touch-up and restore all damaged or defaced surfaces.

END OF SECTION

SECTION 10 14 00

SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the signs in accordance with the plans and as specified herein.

B. **This section includes the following types** of signs:

1. Panel signs.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the signs in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Underwriters' Laboratories, Inc. (UL) and National Electrical Manufacturers Association (NEMA) Compliance**. Provide lighting fixtures and electrical components for illuminated signs that are labeled and listed by UL and comply with applicable NEMA standards.

C. **Single-Source Responsibility**. For each separate type of sign required, obtain signs from one source from a single manufacturer.

D. **Design Criteria**. The drawings indicate sizes, profiles, and dimensional requirements of signs. Other signs with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept. The burden of proof of equality is on the proposer.

1.4 SUBMITTALS

A. **Submit the following** in accordance with Conditions of the Contract and Division 1 specification sections.

1. Product Data. Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

2. Shop Drawings. Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large scale sections of typical

members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

a. Provide message list for each sign required, including large scale details of wording and layout of lettering.

3. Samples. Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
   a. Samples for initial selection of color, pattern, and texture:

      1) Cast Acrylic Sheet Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

1.5 **JOB CONDITIONS**

Not Used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

Not used.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following.

1. Manufacturers of Panel Signs.

   a. ABC Architectural Signing System, Division of Nelson-Harkins Industries.
   b. Architectural Graphics, Inc.
   c. ASI Sign Systems, Inc.

2.2 **MATERIALS**

A. **Cast Acrylic Sheet**. Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 pounds per square inch (psi) when tested in accordance with American Society for Testing and Materials (ASTM) D 790, a minimum allowable continuous service temperature of 176 degrees Fahrenheit (º F.) (80 degrees Celsius [º C.]), and of the following general types.

1. Opaque Sheet. Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.

B. **Plastic Laminate**. Provide high-pressure plastic laminate engraving stock with face and core plies in contrasting colors, in finishes and color combinations indicated or, if not indicated, as selected from the manufacturer's standards.

C. **Fasteners**. Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

D. **Anchors and Inserts**. Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

E. **PANEL SIGNS**

F. **Panel Signs**. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

G. **Unframed Panel Signs**. Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements.

H. **Graphic Content and Style**. Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

I. **Raised Copy**. Machine-cut copy characters from matte finish opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Panel Material. Matte-finished opaque acrylic sheet.
2. Raised Copy Thickness. 1/8 inch.

J. **Applied Copy**. Die cut characters from vinyl film with pressure-sensitive adhesive backing. Apply copy to the exposed face of the sign panel.

1. Panel Material. Matte-finished opaque acrylic sheet.

2.3 **FINISHES**

A. **Colors and Surface Textures**. For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **General**. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

B. **Wall-Mounted Panel Signs**. Attach panel signs to wall surfaces using the methods indicated below:

1. Vinyl Tape Mounting. Use double-sided foam tape, of thickness indicated, to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
2. Silicone Adhesive Mounting. Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous, or vinyl covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.

3.2 CLEANING AND PROTECTION

A. **General**. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION

SECTION 10 14 16

PROJECT PLAQUE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to install the project plaque in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

1.4 SUBMITTALS

A. **Shop Drawings**. Furnish manufacturer's product data, proposed lettering layout, and fasteners for review.

B. **Samples**. Submit two "rubbings" of the plaque for review. The "rubbings" shall show the actual finished lettering in order that the spelling and overall appearance may be reviewed prior to fabrication.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. Package, handle, and store in accordance with the manufacturer's instructions.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **Plaque**. The plaque shall be cast from virgin aluminum ingots. The plaque shall have satin finish raised border with deep block style letters on a black lathered background. The size of the plaque shall be as shown on the drawings.

B. **Text**. The wording shall include the name of the Owner; Burgess & Niple, Inc.; Prime Contractors; and the completion date. Owners' names shall include all of

the official names and titles listed on the title sheet of the drawings or their replacements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification**. The text shall be reviewed by the Contractor for correctness and casting quality.

B. **Location**. The designated wall area for the plaque location shall be free of obstruction and clean.

C. **The wall area** behind the plaque shall be finished in the same manner as the adjacent surfaces so that the plaque may be removed in the future.

3.2 PREPARATION

A. **Fasteners**. The required number of concealed fasteners shall be delivered to the site.

B. **Cleaning**. The wall area onto which the plaque shall be mounted shall be cleaned to the satisfaction of the Owner.

C. **Isolating Coating**. The back of the plaque and the fastener locations shall be coated with epoxy material.

3.3 INSTALLATION

A. **Methods**. The plaque shall be surface mounted with concealed fasteners in a location shown on the drawings or located where directed by the Engineer/Architect.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Inspect the plaque installation and check that each fastener is tight and secure and that the plaque is mounted true and plumb.

END OF SECTION

SECTION 10 21 13

TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the toilet compartments in accordance with the plans and as specified herein.

B. **Types of toilet compartments** include:

1. Metal, stainless steel.

C. **Styles of toilet compartments** include:

1. Floor anchored, overhead braced.

D. **Styles of screens** include:

1. Floor anchored.

E. **Supports for attaching compartments** to overhead structural system are specified in a Division 5 section.

F. **Toilet accessories**, such as toilet paper holders, grab bars, and purse shelves, are specified in another Division 10 section.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the toilet compartments in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Field Measurements**. Take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of work. However, allow for adjustments where taking of field measurements before fabrication might delay work.

C. **Coordination**. Furnish inserts and anchorages which must be built into other work for installation of toilet compartments and related items. Coordinate delivery with other work to avoid delay.

1.4 **SUBMITTALS**

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for materials, fabrication, and installation including catalog cuts of anchors, hardware, fastenings, and accessories.
2. Shop drawings for fabrication and erection of toilet compartment assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.
3. Samples of full range of colors for each type of unit required. Submit 6-inch-square samples of each color and finish on same substrate to be used in work, for color verification after selections have been made.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

Not used.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Stainless Steel.

a. ASI Accurate Partitions Corp.
b. Bobrick Washroom Equipment, Inc.
c. Global Steel Products Corp.
d. Metpar Steel Products Corp.

2. Solid Plastic
a. Scranton Products

2.2 **MATERIALS**

A. **General**. Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.

B. **Stainless Steel Sheets**. ASTM A 167, Type 302/304, finished on exposed faces with No. 4 satin finish, in following minimum thicknesses:

1. Pilasters. 0.0516 inch (18 gauge).
2. Doors, Panels, and Screens. 0.0396 inch (20 gauge).

C. **Concealed Anchorage Reinforcement**. Minimum 0.108-inch (12-gauge), galvanized steel sheet.

D. **Concealed Tapping Reinforcement**. Minimum 0.0785-inch (14-gauge), galvanized steel sheet.

E. **Core Material for Metal Partitions**. Manufacturer's standard sound deadening honeycomb of impregnated Kraft paper in thickness to provide finished dimension of 1 inch minimum for doors, panels, and screens and 1-1/4 inches minimum for pilasters.

F. **Pilaster Shoes and Caps**. ASTM A 167, Type 302/304 stainless steel, not less than 3 inches high, 0.0396 inch thick (20 gauge), finished to match hardware.

G. **Stirrup Brackets**. Manufacturer's standard design for attaching panels to walls and pilasters, either chromium-plated nonferrous cast alloy (Zamac) or anodized aluminum.

H. **Hardware and Accessories**. Manufacturer's standard design, heavy duty operating hardware and accessories of chromium-plated, nonferrous cast alloy (Zamac).

I. **Overhead Bracing**. Continuous extruded-aluminum, antigrip profile, with clear anodized finish.

J. **Anchorages and Fasteners**. Manufacturer's standard exposed fasteners of stainless steel, chromium plated steel, or brass, finished to match hardware, with theft-resistant-type heads and nuts. For concealed anchors, use hot-dip galvanized, cadmium-plated, or other rust-resistant protective coated steel.

2.3 FABRICATION

A. **General**. Furnish standard doors, panels, screens, and pilasters fabricated for compartment system. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition mounted hardware, accessories, and grab bars, as indicated.

B. **Door Dimensions**. Unless otherwise indicated, furnish 24-inch-wide in-swinging doors for ordinary toilet stalls and 32-inch-wide (clear opening) out-swinging doors for stalls equipped for use by handicapped.

C. **Metal Toilet Compartments and Screens**. Pressure-laminate seamless face sheets to core material and seal edges with continuous interlocking strip or with lapped and formed edges. Weld edges and corners with exposed welds ground smooth.

D. **Overhead-Braced Compartments**. Furnish galvanized steel supports and leveling bolts at pilasters as recommended by manufacturer to suit floor conditions. Make provisions for setting and securing continuous, extruded-aluminum, antigrip, overhead bracing at top of each pilaster. Provide shoe at each pilaster to conceal supports and leveling mechanism.

E. **Floor-Supported Compartments**. Furnish galvanized steel anchorage devices complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters to permit structural connection at floor. Provide shoe at each pilaster to conceal anchorage.

F. **Wall-Supported Compartments**. Fabricate divider panels of two steel sheets with internal reinforcing to form unit which is "V" shaped in plan, approximately 6 inches wide at wall and tapered to approximately 1 inch at pilaster. Furnish complete with anchorages and supporting framework for installation in other work. Provide anchorage system with mechanical adjustment for leveling panels.

G. **Wall-Hung Screens**. Furnish panel units in sizes indicated, of same construction and finish as partition system panels.

H. **Hardware**. Furnish hardware for each compartment to comply with American National Standards Institute (ANSI) A117.1 for handicapped accessibility and as follows.

1. Hinges. Cutout inset type, adjustable to hold door open at any angle up to 90 degrees. Provide gravity type, spring-action cam type, or concealed-torsion rod type to suit manufacturer's standards.
2. Latch and Keeper. Recessed latch unit, designed for emergency access, with combination rubber faced door strike and keeper.
3. Latch and Keeper. Manufacturer's standard surface mounted latch unit, designed for handicapped accessibility, with combination rubber faced door strike and keeper.
4. Coat Hook. Manufacturer's standard unit, combination hook and rubber tipped bumper, sized to prevent door hitting mounted accessories.
5. Door Pull. Manufacturer's standard unit for out swinging doors. Provide pulls on both faces of handicapped compartment doors.

2.4 FINISH

A. **Color**. Manufacturer's standard stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**. Comply with manufacturer's recommended procedures and installation sequence. Install compartment units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch between pilasters and panels, and not more than 1 inch between panels and walls. Secure panels to walls with not less than two stirrup brackets attached near top and bottom of panel. Locate wall brackets so that holes for wall anchorages occur in masonry or tile joints. Secure panels to pilasters with not less than two stirrup brackets located to align with stirrup

brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.

B. **Overhead-Braced Compartments**. Secure pilasters to floor and level, plumb, and tighten installation with devices furnished. Secure overhead brace to each pilaster with not less than two fasteners. Hang doors and adjust so that tops of doors are parallel with overhead brace when doors are in closed position.

C. **Floor-Supported Compartments**. Set pilaster units with anchorages having not less than 2 inches penetration into structural floor, unless otherwise recommended by partition manufacturer. Level, plumb, and tighten installation with devices furnished. Hang doors and adjust so that tops of doors are level with tops of pilasters when doors are in closed position.

D. **Wall-Supported Compartments**. Secure divider panels to built-in anchorage devices using concealed fasteners. Level, plumb, and tighten installation with devices furnished. Hang doors and adjust so that bottoms of doors are level with bottoms of pilasters when doors are in closed position.

E. **Screens**. Attach with anchoring devices as recommended by manufacturer to suit supporting structure. Set units to provide support and to resist lateral impact.

3.2 ADJUST AND CLEAN

A. **Hardware Adjustment**. Adjust and lubricate hardware for proper operation. Set hinges on in swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out swinging doors (and entrance swing doors) to return to fully closed position.

B. **Clean exposed surfaces** of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION

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SECTION 10 28 00

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the toilet and bath accessories in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards referenced herein.

1. ASTM – American Society for Testing and Materials.
2. FS – Federal Specifications.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's technical data and installation instructions for each unit. Technical data shall show manufacturer's trade name, colors, model number, cleaning instructions, storage, and maintenance requirements.

B. **Shop Drawings**. Submit drawings showing location and layout, anchoring details, hardware, sizes, type, finish, and grade.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate with other trades for installation of anchors, inserts, mounting, and other conditions so as not to cause delays, omissions, and errors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Do not deliver toilet accessories until building is enclosed and ready for accessories.

B. **Storage**. Store accessories in original clearly marked packaging until ready for installation. Protect from damage at all times.

C. **Handling**. Handle per manufacturer's instruction at all times.

1.7 **SPECIAL WARRANTY**

A. **Mirrors**. As noted.

PART 2 - PRODUCTS

2.1 **COMBINATION MIRROR, PAPER TOWEL DISPENSER, AND SOAP DISPENSER**

A. **Type**. Recessed.

B. **Style**. Multipurpose unit.

C. **Size**. 600 C-fold towels with interchangeable paper drop.

D. **Material.** Type 304 stainless steel. 20 gauge.

E. **Finish**. No. 4 Satin.

F. **Manufacturer/Model**

1. Bobrick B-3302.
2. Bradley 130.

2.2 **WASTE RECEPTACLE**

A. **Type**. Surface mounted.

B. **Size**. 6.4-gallon capacity.

C. **Material**. Type 304 stainless steel.

D. **Finish**. No. 4 Satin.

E. **Accessories**. Removable vinyl liner.

F. **Manufacturer/Model**

1. Bobrick B-279.
2. Bradley 357.

2.3 **TOILET TISSUE DISPENSER**

A. **Type**. Surface mounted.

B. **Size**. Two roll.

C. **Material**. Type 304 stainless steel.

D. **Finish**. No. 4 Satin.

E. **Manufacturer/Model**

1. Bobrick B-2840.
2. Bradley 528.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Prior to installation of toilet and bath accessories, verify that:

1. All clearances have been or will be met.
2. Bases, anchors, supports, and openings are located correctly and are of the proper sizes and materials.

B. **Variations**. Correct any variations from the requirements shown on the drawings at no additional cost to the Owner. Submit all methods of correction in writing for approval and acceptance.

3.2 PREPARATION

A. **Protection**. Protect all surface areas from damage. Protect all finished walls and floors with adequate covering to prevent scratches, chips, and/or stains.

3.3 INSTALLATION

A. **Fasteners**. Use concealed fastenings wherever possible. All fasteners and anchors to be Type 316 stainless steel.

B. **Anchors**. Provide anchors, bolts, and other necessary anchorages, and attach accessories securely to walls and partitions in locations as shown.

C. **Mounting**

1. Install concealed mounting devices and fasteners fabricated of the same material as the accessories as recommended by manufacturer.
2. Install exposed mounting devices and fasteners finished to match the accessories.
3. Provide theft-resistant fasteners for all accessory mountings.

D. **Accessories**. Secure toilet room accessories in accordance with the manufacturer's instructions for each item and each type of substrate construction.

3.4 ADJUSTMENT AND CLEANING

A. **Adjustment**. Adjust accessories for proper operation.

B. **Cleaning**. After completion of installation, clean and polish all exposed surfaces.

3.5 **DEMONSTRATION**

A. **Visual**. With Owner and/or Engineer/Architect, inspect each unit for visual deficiencies and to ensure that all units are secure and all colors and finishes are uniform.

B. **Tests**. Demonstrate that all units operate easily and freely, all latches and locks operate satisfactorily, and all units are securely fastened.

3.6 **PROTECTION**. Provide protection of each unit until final acceptance, and remove same at completion of the project or when directed.

END OF SECTION

SECTION 10 44 00

FIRE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install fire equipment in accordance with the plans and as specified herein.

B. **This section includes the following**:

1. Fire extinguishers.
2. Mounting brackets.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install fire equipment in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Underwriters' Laboratories, Inc. (UL) Listed Products**. Fire extinguishers UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher.

C. **Factory Mutual (FM) Listed Products**. Fire extinguishers approved by FM Research Corporation for type, rating, and classification of extinguisher and carry appropriate FM marking.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections.

1. Product Data. Product data for each type of product specified.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Ansul Fire Protection, Wormald US Inc.
2. J.L. Industries.
3. Larsen's Manufacturing Co.

2.2 FIRE EXTINGUISHERS

A. **General**. Provide fire extinguishers for each location indicated, in colors and finishes selected by Engineer/Architect from manufacturer's standard, which comply with requirements of governing authorities.

1. Fill and service extinguishers to comply with requirements of governing authorities and manufacturer.
2. Abbreviations indicated below identify extinguisher types related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

B. **Multipurpose Dry Chemical Type**. UL-rated 2-A:10:B:C, 5-pound nominal capacity, in enameled steel container.

2.3 MOUNTING BRACKETS

A. **General**. Provide brackets designed to prevent accidental dislodgement of extinguisher, of sizes required for type and capacity of extinguisher indicated in plated finish.

1. Provide brackets for extinguishers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

1. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

2. Where exact location of bracket-mounted fire extinguishers is not indicated, locate as directed by Engineer/Architect.

END OF SECTION

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SECTION 10 51 13

METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install metal lockers in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Dimensions**. Verify all dimensions and quantities at the building. Where lockers are shown wall to wall, provide end closers and fillers as required.

B. **Installation**. Installer shall be approved by the manufacturer and experienced in the assembly of locker parts.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's product data consisting of product specifications, installation instructions, finishes, and accessories.

B. **Shop Drawings**. Show metal lockers in dimensioned relation to adjacent surfaces. Show lockers in detail, method of installation, fillers, trim, base, door swing, and accessories. Include locker numbering sequence information.

C. **Samples**. Submit samples for each color on squares of same metal to be used for fabrication of lockers. Furnish not less than six colors.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate layout and installation with other trades to ensure proper enclosure and prevent delay in work, errors, and/or omissions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery.

B. **Storage**. Store lockers and locker accessories off the ground and not exposed to the elements. Keep in original packaging until used.

C. **Handling**. Handle lockers per manufacturer's recommendations, without scratching and/or damages.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Sheet Steel**. Mild cold rolled and leveled furniture steel, free from buckle, scale, and surface imperfections.

B. **Fasteners**. Cadmium, zinc, or nickel plated steel; exposed bolt heads, slotless type; self-locking nuts or lock washers for nuts on moving parts.

C. **Equipment**. Hooks and hang rods of cadmium plated or zinc plated steel.

D. **Number Plates**. Manufacturer's standard etched, embossed, or stamped, aluminum or stainless steel metal number plates with embossed numerals not less than 3/8 inch high. Number lockers in sequence as directed by Engineer/Architect. Attach plates to each locker door, near top, centered, with at least two fasteners of same finish as number plate.

2.2 **FABRICATION**

A. **Construction**. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch. Weld frame members together to form rigid, one-piece structure. Weld, bolt, or rivet other joints and connections. Grind exposed welds flush. Do not expose bolts or rivet heads on fronts of locker doors or frames.

B. **Frames**. Fabricate of 16-gauge channels or 12-gauge angles, minimum with continuous stop/strike formed on vertical members.

C. **Finishing**. Chemically pretreat metal with degreasing and phosphatizing process. Apply baked on enamel finish to all surfaces, exposed and concealed, except plates and nonferrous metal.

1. Color. Provide locker units in color(s) selected by Engineer/Architect from manufacturer's standards. Concealed parts may be manufacturer's standard neutral color.

D. **Body**. Fabricate back of 18-gauge steel and sides of 16-gauge steel, with double-flanged connections extending full height. Form top and bottom of not less than 16-gauge steel, with flanged edges.

1. Provide not less than 20-gauge steel sheet hat shelf set approximately 9 inches below the top. Shelf to be flanged on all sides with channel front.

E. **Door**. One-piece, minimum 14-gauge sheet steel, flanged at all edges, constructed to prevent springing when opening or closing. Fabricate to swing 180 degrees.

1. Reinforcing. Provide extra bracing or reinforcing on inside of doors over 15 inches wide.
2. Ventilation. Provide stamped, louvered vents in door face, as is standard with the manufacturer.
3. Hinges. Steel, full-loop, five-knuckle, nonremovable pin. Weld to inside of frame and secure to door with not fewer than two factory-installed fasteners that are completely concealed and tamperproof when door is closed. Provide at least three hinges for each door over 42 inches high; at least two hinges for doors 42 inches high or less.

F. **Projecting Handle and Latch**. Positive automatic, prelocking, stainless steel, pry-resistant latch, recessed and pull with rubber silencers; chromium plated, heavy duty, vandalproof lift up handle, containing strike and eye for padlock; and with not less than three-point latching action.

G. **Equipment**. Furnish each locker with hat shelf, one double prong hook, and not fewer than three single prong wall hooks.

H. **Filler Panels**. Provide filler panels where indicated, of not less than 16 gauge steel sheet, factory fabricated and finished to match locker units.

2.3 MANUFACTURERS

A. **Manufacturer**. Subject to compliance with requirements, provide products of one of the following:

1. Debourgh.
2. The Interior Medart.
3. List Industries, Inc.
4. Republic Storage Systems.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Prior to installation of lockers, verify that:

1. All clearances have been or will be met.
2. Bases, anchors, supports, and openings are located correctly and are of the proper sizes and materials.

B. **Variations**. Correct any variations from the requirements shown on the drawings at no additional cost to the Owner. Submit all methods of correction in writing approval and acceptance.

3.2 PREPARATION

A. **Protection**. Protect all surface areas from damage. Protect all finished floors with adequate covering to prevent scratches, chips, and/or stains.

3.3 INSTALLATION

A. **General**

1. Install metal lockers on concrete bases at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.
2. Space fasteners approximately 48 inches on center (o.c.), unless otherwise recommended by manufacturer, and apply through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners. All fasteners projecting into the locker area shall be finished with crown dome nuts.
3. Install trim and metal filler panels using concealed fasteners. Provide flush, hairline joints against adjacent surfaces.

3.4 **REPAIRS/RESTORATION**

A. **Damages**. Satisfactorily repair all chips, scratches, stains, and other disfiguring conditions of all units and accessories. Replace any unit that cannot be repaired satisfactorily at no additional cost to the Owner.

3.5 **ADJUSTING**. Adjust all doors to operate easily without binding and to open and close freely, and verify that all locking devices are operating properly.

3.6 **CLEANING**. Clean units of all marks, mars, smears, and foreign materials to a factory finish appearance. Use only material and methods recommended by the locker manufacturer.

3.7 **DEMONSTRATION**

A. **Visual**. With Owner and/or Engineer/Architect, inspect each unit for visual deficiencies and to ensure that all exposed fasteners within each unit are capped and all colors and finishes are uniform.

B. **Tests**. Demonstrate that all locker doors operate easily and freely without binding and/or twisting, all latches and locks operate satisfactorily, and all units are securely fastened.

3.8 **PROTECTION**. Provide protection of each unit until final acceptance, and remove same at completion of the project or when directed.

END OF SECTION

SECTION 11 01 00

SAFETY EQUIPMENT

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. **General**. Drawings and general provisions of the Contract and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the safety equipment for use by operation and maintenance personnel working within the confined space of the chlorine contact tanks and clearwell.

B. Equipment to be provided includes the following:

1. Confined space personal safety equipment in accordance with the plans and as specified herein.

C. **Types**. Types of equipment required for project include the following:

1. Provide two (2) vest type safety harnesses, each with two (2) aluminum D-ring shoulder and back d-rings for confined space use with Portable Fall Arrest System (PFAS).

2. Provide sixteen (16) Portable Fall Arrest Anchor Posts and two (2) Rescue Davit Arm made of light-weight Aluminum with Four (4) Heavy Duty Carrying Bags for PFAS Davit Arm.

3. Provide two (2) drill operated power winch and two (2) self-retracting lifelines.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the life safety equipment in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1.4 SUBMITTALS

A. **General**. Comply with Section 01 33 00, “Submittals” and submit following supplemental requirements within this specification section.

B. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

C. **Shop Drawings**. Submit plans, elevations and details for work not fully shown by published product data; include rough-in dimensions and service connection details.

1.5 JOB CONDITIONS

A. **General**. Handle, store, and protect items in accordance with Section 01 60 00 and the manufacturer’s instructions. Mount units after new hand railing systems are installed. Coordinate locations with Owner/Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING (Not used)

1.7 SPECIAL WARRANTY (Not used)

PART 2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. **General**. Provide manufacturer's standard packaged, pre-engineered or prefabricated units except as otherwise indicated, with selections as indicated to comply with requirements; and with components of each unit complying with manufacturer's published product literature, and as required for a complete system.

B. **Stainless Steel**. American Iron and Steel Institute (AISI) Type 302/304, with manufacturer's standard directional polish or satin finish on exposed surfaces.

C. Confined Space Safety Equipment

1. Portable Fall-Arrest Post (PFAP)

a. Provide 4-stage telescoping post constructed of lightweight aluminum for easy transport and setup. The 4-position extendable post shall support 3 independent swivel tie-offs for fall arrest anchorage and accommodate attachment of portable davit arm. Post shall be Portable Fall Arrest Post with three independent tie-off points that provide 360-degree protection for 3 workers. Provide a 18-inch adjustable offset to the increase the mast height. Base of post shall be constructed of aluminum and designed with built-in lifeline attachment, leveling screws to plumb system and stainless-steel pin for attachment to anchor plate.

b. Provide for field welding to embedded steel anchor plate in concrete deck at designated locations. Anchor plate shall be epoxy coated steel, heavy floor anchor base plate and properly sized anchor bolts to handle 50% of maximum design loads in case of one fallen worker and 2 additional workers assisting his removal. Stainless steel removable pins shall be used to retain post for easy setup and tear down.

c. Provide heavy duty Portable Fall-arrest Anchor Post Bag. Bag shall be constructed from heavy duty materials with rugged zippers, padded side panels and adjustable carrying straps.

2. Portable Davit

a. Provide portable davit for attachment of winches and fall protection devices. Davit shall include quick-attach screws fittings to attach Rescue Davit to post. Anchorage cables shall be provided to retain davit arm in correct position. Davit shall work in two positions and extend 42-inches out from the post. Davit shall work in only the 2nd and 4th positions. Davit shall work in only the 2nd and 4th positions. Davit shall be Model 8516693 manufactured by DBI-SALA or equal, and shall attach to 4 position PFAP Model 8516691 post by DBI-SALA or equal

b. Davit shall be provided with brackets designed for mounting of winch and self-extracting lifeline.

c. Provide heavy duty bag for carrying davit with permanently mounted winch. Provide heavy duty Portable Fall-arrest Anchor Post Bag. Bag shall be constructed from heavy duty materials with rugged zippers, padded side panels and adjustable carrying straps. Bag shall be able to store Davit Arm and permanently mounted winch.

d. Provide sixteen (16) **Bolt-On Uni-Anchor with Tie-Off Zinc Plated** floor mount base plates Model 85000009 as manufactured by DB SALA or approved equal. Provide 1" grout under base and attach floor flange to concrete with 4-1/2" 316 stainless steel anchor bolts set in a ¾" hole with epoxy adhesive.

e. Furnish and install sixteen (16) base plate for mounting portable PFAS post at locations shown on the plans including and summarized in the schedule herein.

3. Winch

a. Retrieval and rescue wind shall be compact design, constructed of 304 stainless steel. Winch shall be permanently mounted to davit arm.

b. Winch shall be equipped with digital indicator that counts revolutions of the drum to determine next service interval. Standard features include a braking system with three

a) independent working pawls, centrifugal back-up brake, and carrying handle and cable retainer spring. Winch shall include double locking swivel safety snap will be provided. All components are zinc-plated or anodized aluminum.

c. A friction brake shall be engaged by a minimum of 2 kg. Brake pad wear indicator monitors the condition of braking mechanism and shall include an inertial (centrifugal) safety back-up brake.

d. Winch shall be able to be operated through a power drive hub on the 9:1 drive. An overload clutch shall be provided to install between the power hub drive and the electrical or pneumatic drill to eliminate overloading the winch during retrieval. This clutch shall protect the winch operator and the retrieved worker from injury. The clutch is installed and removed with the use of special tools when switching to the manual 4:1 manual crank drive option. A two speed gear reduction shall be used to provide the capability of retrieval/descent at an average speed from 4 meter/minute up to 9 meter/minute/. Two speed manual winches shall utilize removable aluminum crank winch. Unit shall be provided with minimum 100 feet of stainless steel cable.

4. Self-Retracting Lifeline (SLR) for Emergency Escape Device.

a. Provide two (2) sealed Self-Retracting Lifeline with automatic rewind. Sealed unit to be constructed of corrosion resistant materials with 304 stainless steel cables and snap hooks, suitable for mounting on Portable Anchor Post or Davit. Centrifugal speed regulator shall control speed of descent to 4 feet per second.

Maximum load is 450 pounds. Lifeline shall contain 200 feet of stainless steel cable.

b. SRLs incorporate a sealed design separates all dynamic components including the motor spring and brake, from foreign elements such as grease, moisture and dirt.

5. Harness

a. Provide two (2) full body harness with two (2) D-Ring on shoulder and one (1) on back.

6. **Approved manufacturers** for confined space safety systems shall be:

a. DBI-SALA

b. Pelsue

c. DCIS Inc.

d. Approved equal.

2.2 FABRICATION

A. **General**. Fabricate with manufacturer's standard joints and seams, with exposed edges smoothed. Provide mounting brackets and hardware sized and spaced to withstand impacts and pressures of normal operations, suitable for mounting to aluminum hand railing.

PART 3 EXECUTION

3.1 **Installation.** Contractor shall install all equipment at the locations shown on the contract drawings per the manufacturer’s recommendation. Provide on-site training by the manufacturer’s technical representative, on the proper use of the equipment. Training shall be conducted in two separate sessions for a total of 6 hours of instruction.

PART 4 PART 4 - EQUIPMENT SCHEDULE

4.1 GENERAL

A. Locations

-Two (2) West Aerator Building
-One (1) East Aerator Building
-Four (4) Exterior Entry Hatches to Clearwells
-Two (2) Filter Gallery for Filters #5 and #6
-One (1) Floor Hatch in Lobby
-Four (4) Access Hatches to Clearwells, Chlorine Contact Tanks, & Fluoridation Tanks
-Two (2) at High Service Pump Chamber No.1&2.

PFAS Post Quantity	2
Anchor Post Extensions	2
Base Concrete Anchors	16
Davit Arms w/ Bracket	2
Heavy Duty Storage Bags	2
SS Wire Rope Retrieval Winch w/ Carabiner	2
Full Body Harness	2 (1 LG & 1 XL)
SS Carabiner (*)	2
Capacity	450-lbs
Maximum boom extension (from center of mast to end of boom)	42-inches

(Does not include allowance for grout or a steel leveling plate if required to distribute load of yoke assembly to concrete floor)

* Provide CMC Rescue ProTech Auto-Lock Stainless Steel Carabiner NFPA G Rated with each Davit system.

END OF SECTION

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SECTION 13 34 23.05

SMALL METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the metal building systems in accordance with the plans and as specified herein. This section includes all materials and erection required for building to be supplied complete with all necessary component parts, including foundation anchors, to form a complete building system and all parts shall be new and free from all defects or imperfections. The building width and length shall be measured from the outside of the building wall panels and the height of the building shall be the distance measured from the bottom surface of the base channel to the exterior juncture of the roof and sidewall panels.

B. **This section includes a single-story, single-span**, rigid-frame-type pre-engineered metal building of the nominal length, width, eave height, and gable roof pitch indicated.

1. Exterior walls are covered with field-assembled insulated wall panels attached to framing members using exposed fasteners. End walls are not expandable.
2. Gable Roof system consisting of the manufacturer's standard standing seam insulated roof.
3. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.

C. **Related Sections**. The following sections contain requirements that relate to this section:

1. Division 3 – Cast-in-Place Concrete. Concrete floor and foundations and installation of anchor bolts are specified in Division 3 and are to be coordinated with the manufacturer’s recommendations.
2. Sealants and caulking are specified in Division 7.
3. Sectional Overhead Doors are specified in Division 8.
4. Fiberglass reinforced plastic (FRP) Doors are specified in Division 8.

5. Finish hardware and provisions for master-keying are specified in Division 8.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install the metal building systems in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Installer Qualifications**. Engage an experienced installer to erect the pre-engineered metal building who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.

C. **Manufacturer Qualifications**. Provide pre-engineered metal buildings manufactured by a firm experienced in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance.

D. **Single-Source Responsibility**. Obtain the metal building system components, including structural framing, wall and roof covering, and accessory components, from one source from a single manufacturer.

E. **Design Criteria**. The drawings indicate size, profiles, and dimensional requirements of the pre-engineered metal buildings and are based on the specific type and model indicated. Metal building systems having equal characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the Engineer/ Architect. The burden of proof of equality is on the proposer.

1.4 SUBMITTALS

A. **General**

1. All submittals shall be submitted in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Product Data. Product data consisting of metal building system manufacturer's product information for building components and accessories.

2. Shop Drawings. Shop drawings for metal building structural framing system, roofing and siding panels, and other metal building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data.

a. Structural Framing. Furnish complete erection drawings prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the project is located. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, end wall, and roof framing. Include transverse cross sections.

b. Roofing and Siding Panels. Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross sections.

c. Building Accessory Components. Provide details of metal building accessory components to clearly indicate methods of installation including the following:

1) Personnel Doors. Provide elevations and details of each type of door and frame, including anchors and reinforcement; show location and installation requirements for finish hardware. Provide schedule of doors and frames using the same reference numbers for details and openings as those indicated on the drawings; include complete hardware schedule.

2) Sheet Metal Accessories. Provide layouts at 1/4-inch scale. Provide details of ventilators, louvers, gutters, downspouts, pipe penetrations, and other sheet metal accessories at not less than 1-1/2-inch scale showing profiles, methods of joining, and anchorages.

C. **Submittal Package No. 2 – Samples for Initial Selection Purposes**

1. Samples for Initial Selection Purposes. In the form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for metal roofing and siding panels with factory-applied finishes.

D. **Submittal Package No. 3 – Samples for Verification Purposes and Certification**

1. Samples for Verification Purposes. Of roofing and siding panels. Provide sample panels 12 inches long by actual panel width, in the

profile, style, color, and texture indicated. Include clips, battens, fasteners, closures, and other panel accessories.

2. Installer Certificates. Signed by metal building manufacturer written certification certifying that the installer complies with requirements included under the "Quality Assurance" Article.

3. Professional Engineer's Certificate. Prepared and signed by a Professional Engineer, legally authorized to practice in the jurisdiction where project is located, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.

E. **Submittal Package No. 4 –Building Code Submittals**

1. Provide all request drawings, design calculations, and other miscellaneous submittals as required by the governing authorities during jurisdiction. Submittals shall be in a form acceptable to the governing authority and shall be submitted in a timely manner so as not to delay the plan approval process.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.

B. **Handling**. Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.

C. **Storage/Protection**. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

1.7 SPECIAL WARRANTY

A. **Roofing and Siding Panel Finish Warranty**. Furnish the roofing and siding panel manufacturer's written warranty, covering failure of the factory applied exterior finish on metal wall and roof panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may

1. Warranty period for factory-applied exterior finishes on wall and roof panels is 20 years after the date of Substantial Completion.

1.8 SYSTEM PERFORMANCE REQUIREMENTS

A. **General**. Engineer, design, fabricate and erect the pre-engineered metal building system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.

1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in Metal Building Manufacturers Association's (MBMA) "Design Practices Manual."

B. **Design Loads**. Basic design loads, as well as auxiliary and collateral loads, are indicated on the drawings.

1. Basic design loads include live load, wind load, and seismic load, in addition to the dead load.
2. Auxiliary loads include dynamic live loads such as those generated by cranes and material handling equipment.
3. Collateral loads include additional dead loads over and above the weight of the metal building system such as sprinkler systems and roof mounted mechanical systems.

C. **Structural Framing and Roof and Siding Panels**. Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the MBA's "Design Practices Manual."

1. Structural Steel. Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.
2. Light Gauge Steel. Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gauge Steel Diaphragms" for design requirements and allowable stresses.
3. Welded Connections. Comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures.

D. **Building Accessories**. Provide metal building system accessories that comply with the following criteria:

1. Doors and Frames shall be Fiberglass Reinforced Plastic (FRP) per Specification Section 08 71 50.
2. Sectional Overhead Doors shall be per Specification Section 08 36 13.

3. Door hardware shall be powder coated or stainless steel per Specification Section 08 71 00.

1.9 EXTRA MATERIALS

A. **Maintenance Stock**. Furnish at least 5 percent excess over required amount of nuts, bolts, screws, washers, and other required fasteners for each metal building. Pack in cartons labeled to identify the contents and store on the site where directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering metal building systems that may be incorporated in the work include but are not limited to the following:

B. **Manufacturer**. Subject to compliance with specified requirements, provide metal building systems provided by one of the following:

1. Cornerstone Building / MCBI
2. Star Building Systems
3. Parkline, Inc.
4. A&S Building Systems
5. American Buildings Company
6. Or Equal

2.2 MATERIALS

The following materials specifications apply as required for the products used in the approved building system.

A. **Hot-Rolled Structural Steel Shapes**. Comply with ASTM A 36 or A 529.

B. **Steel Tubing or Pipe**. Comply with ASTM A 500, Grade B, ASTM A 501, or ASTM A 53.

C. **Steel Members Fabricated from Plate or Bar Stock**. Provide 42,000 pounds per square inch (psi) minimum yield strength. Comply with ASTM A 529, ASTM A 570, or ASTM A 572.

D. **Steel Members Fabricated by Cold Forming**. Comply with ASTM A 607, Grade 50.

E. **Cold-Rolled Carbon Steel Sheet**. Comply with requirements of ASTM A 366 or ASTM A 568.

F. **Hot-Rolled Carbon Steel Sheet**. Comply with requirements of ASTM A 568 or ASTM A 569.

G. **Structural-Quality Zinc-Coated (Galvanized) Steel Sheet**. Comply with ASTM A 653 with G90 coating. Grade to suit manufacturer's standards.

H. **Aluminum Zinc Alloy.** ASTM A792 with coating conforming to AZ%% (55%) standard by hot dipping process.

I. **Commercial-Quality Zinc-Coated (Galvanized) Steel Sheet**. Comply with ASTM A 653 with G60 coating.

J. **Aluminum-Coated Steel Sheets**. Comply with ASTM A 463 with T1-40 coating.

K. **Aluminum Sheets**. Comply with ASTM B 209 for Alclad alloy 3003 or 3004 with temper as required to suit forming operations.

L. **Bolts for Structural Framing**. Comply with ASTM A 307 or ASTM A 325 as necessary for design loads and connection details.

M. **Thermal Insulation**. Glass fiber blanket insulation, complying with ASTM C 991, of 0.5 pounds per cubic foot density, thickness as indicated, with UL flame spread classification of 25 or less, and 2 inch wide continuous vapor tight edge tabs.

1. Vapor Barrier. Vinyl reinforced foil or Foil reinforced kraft paper.
2. Retainer Strips. 26-gauge (0.0179-inch) formed galvanized steel retainer clips colored to match the insulation facing.

N. **Paint and Coating Materials**. Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of federal specifications indicated is not required.

1. Shop Primer for Galvanized Metal Surfaces. Zinc-dust zinc-oxide primer selected by the manufacturer for compatibility with substrate. Comply with FS TT-P-641.

2.3 STRUCTURAL FRAMING

A. **Framing**. Provide the following framing members:

1. Flange and Sag Bracing. 1 5/8-inch-by-1-5/8-inch angles fabricated from 16-gauge (0.0598-inch) shop-painted roll-formed steel.

2. Base or Sill Angles. Fabricate from 14-gauge (0.0747-inch) cold-formed galvanized steel sections.

3. Secondary end wall structural members, except columns and beams, shall be the manufacturer's standard sections fabricated from 14-gauge (0.0747-inch) cold-formed galvanized steel.

B. **Wind Bracing**. Provide adjustable wind bracing using 1/2-inch-diameter threaded steel rods or manufacturer standard units; comply with ASTM A 36 or ASTM A 572, Grade D. Locate interior end bay bracing only where indicated.

C. **Bolts**. Provide shop-painted bolts except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.

D. **Shop Painting**. Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of Steel Structures Painting Council (SSPC) SP3 for power tool cleaning, SSPC-SP7 for brush off blast cleaning, and SSPC-SP1 for solvent cleaning.

1. Prime structural steel primary and secondary framing members with the manufacturer's standard rust-inhibitive primer.
2. Prime galvanized members, after phosphoric acid pretreatment, with manufacturer's standard zinc-dust zinc-oxide primer.

2.4 ROOFING AND SIDING PANELS

A. **Roof and Ceiling Panels**.

1. General. Roof panels shall be supplied in a single continuous length from eave line to eave line or ridge line and shall be designed to tightly interlock so that no fasteners are required at intermediate points along the panel side laps. Roof panels shall be 24”, 18", or 12" wide with a smooth surface between the interlocking side ribs. The interlocking ribs shall be a minimum 3" high and shall be turned upward. All roof panels shall be factory punched for connection at the eave line of the building.
2. Fasteners. There shall be no fastener penetrations through the roof covering except at eave lines, ridge lines and roof accessory openings such as skylights and ventilators. Provide a snap-together, trapezoidal standing seam roof system shall be Ultra-Dek as manufactured by MBCI or approved equal
3. Finish. Roof panels shall be a nominal 26 gauge steel coated on both sides with a coating of corrosion resistant aluminum-zinc alloy conforming to ASTM A 792 specification with the coating conforming to AZ55 (55%) standard by a continuous hot dipping process. Coating weight shall be a minimum of 0.50 oz. of aluminum-zinc alloy per square foot of coated sheet equivalent to about 0.8 mil thickness on each side.

Minimum yield strength of panel material shall be 50,000 PSI. Coating shall be Signature 300 as manufacture red by MBCI or approved equal.

4. Ceiling Panels. The metal ceiling system consists of 3" deep 16" wide interlocking panels of nominal 26 gauge embossed galvanized steel, factory painted White. The ceiling system is supported at its perimeter by concealed angles and hook bolts. The ceiling system is furnished complete with all necessary connectors and fasteners. Roof and wall interior liner panels shall be Ultra-Dek metal structural panel with exposed fastener system as manufactured by MBCI or approved equal.
5. Insulation. The ceiling shall be insulated with 2 layers of 16" wide by 3 1/2" thick R-26 unfaced fiberglass insulation laid at right angles to the panel fibs. The "U" value through the finished ceiling would be a maximum of 0.05 BTU's per square foot (R21.3) when calculated in accordance with the "Zone Method" contained in ASHRAE "Handbook of Fundamentals", 1981 edition. Eave height -9".

B. Wall Panels.

1. General. Exterior wall panels of the building shall be a single continuous length from the base channel to the roof line of the building at the sidewalls and end walls of the building except where interrupted by wall openings.
2. Dimensions.
   a. Exterior Wall Panels. Wall panel system shall be up to 36” wide with exposed metal fastener system, with ribs at 12” spacing with a rib depth of 1-1/8" high. Wall panels shall be AVP metal structural panel with exposed fastener system as manufactured by MBCI or approved equal.
   b. Interior Liner Wall Panels. Roof and wall interior liner wall and ceiling liner panels with maximum coverage of 36-inches shall have 1-1/4”-inch ribs and a rib spacing of 12" centers with a rib standing 1-1/8, with exposed fastener system. Wall and ceiling liner panels shall be PBR metal structural panel with exposed fastener system as manufactured by MBCI or approved equal.
3. Fasteners. Wall panels system is furnished complete with all necessary connectors and utilize and exposed fastener system.. manufactured by MBCI or approved equal.
4. Material Properties. Wall panels shall be nominal 26-gauge galvanized steel conforming to ASTM A-653 specifications with the galvanized coating conforming to G90 (1.25 oz. commercial) standards. Minimum yield strength of panel material shall be 40,000 PSI. Panel material shall be embossed with a random pattern pebble embosser of approximately .007 - .008 depth.
5. Coatings.
   a. All exterior surfaces of the galvanized steel wall covering, and exterior trim shall receive a factory, roller applied, paint coating having an exterior coating thickness of 0.8 to 1.2 mils of dry film thickness. The finish coat for wall panels shall be a siliconized polyester formulation of one of the Manufacturer’s standard

colors. Coating shall be equal to Signature 300 as manufactured by MBCI or equal. Interior Liner panel color shall be white.

b. The wall panel color coating shall carry a low fire hazard rating equal to a Class 1 material as defined by Factory Mutual. The panel coating shall have achieved a Flame Spread Index of 0 and a Fuel Contributed Index of 5 or less when tested in accordance with ASTM E-84 test procedures.

c. Exterior color coatings shall meet the following performance standards after 10 years continuous exposure in normal atmospheric conditions not containing corrosive fumes such as chemical fumes or salt spray.

1) Panels shall show no evidence of blistering, peeling, or chipping.

2) Panels shall not show surface chalking in excess of the No. 8 rating D659 as established by the American Society of Testing Materials (ASTM).

3) Panels, after cleaning, shall not show color change in excess of five (5) NBS units when measured in accordance with the ASTMD-2244 standard.

4) The above performance standards shall not apply where panels have been damaged by fire, radiation or other physical damage.

6. Insulation. Interior wall insulation shall be 3-1/2" R13 fiberglass.

7. Coating shall be Signature 300 as manufacture red by MBCI or approved equal.

C. **Fasteners**. Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end welded studs, and other suitable fasteners designed to withstand design loads.

1. Provide metal backed neoprene washers under heads of fasteners bearing on weather side of panels.
2. Use aluminum or stainless steel fasteners for exterior application and galvanized or cadmium plated fasteners for interior applications.
3. Locate and space fastenings in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.
4. Provide fasteners with heads matching color of roofing or siding sheets by means of plastic caps or factory applied coating.

D. **Accessories**. Provide the following sheet metal accessories factory-formed of the same material in the same finish as roof and wall panels.

1. Flashings.
2. Closers.
3. Fillers.
4. Metal expansion joints.
5. Ridge covers.
6. Fascias.

E. **Flexible Closure Strips**. Closed cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premold to match configuration of roofing and siding sheets. Provide closure strips where indicated or necessary to ensure weathertight construction.

F. **Sealing Tape**. Pressure sensitive 100 percent solids grey polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

G. **Joint Sealant**. One part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.

2.5 PERSONNEL DOORS

A. General. Provide openings to accept FRP door(s) and frames specified in Division 8 and as shown on the plans. Contractor is responsible for coordinating matching of openings and doors between the respective manufacturers.

2.6 SHEET METAL ACCESSORIES

A. **General**. Provide aluminum sheet metal accessories with aluminum roofing and siding panels.

B. **Gutters**. Form in 8-foot-long sections, complete with end pieces, outlet tubes, and other special pieces as required. Size in accordance with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). Join sections with riveted and soldered or sealed joints. Provide expansion type slip joint at center of runs. Furnish gutter supports spaced 36 inches on center, constructed of same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish to match roof fascia and rake.

C. **Downspouts**. Form in 10-foot-long sections, complete with elbows and offsets. Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 5 feet on center in between. Finish to match wall panels.

D. **Wall Louvers**. Provide louvers, size and design indicated, of 18-gauge (0.0478-inch) steel. Fold or bead blades at edges, set at an angle that excludes driving rains, and secure to frames by riveting or welding. Finish to match wall panels.

1. Provide vertical mullions for louvers 4 feet and more in width, with one mullion for each 4 feet of width.
2. Provide flanges on interior face of frames where air intake or exhaust louvers are indicated to be connected with mechanically operated dampers or metal ductwork.
3. Provide 1/2" x 1/2" galvanized steel mesh bird screens in rewirable frames on exterior face of louvers. Secure with clips to ensure ease of

removal for cleaning and rewiring. Fabricate screens and frames of same type metal as louvers.

2.7 FABRICATION

A. **General**. Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly.

1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.
2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

B. **Structural Framing**. Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop drilled or punched to template dimensions.

1. Shop Connections. Provide power riveted, bolted, or welded shop connections.
2. Field Connections. Provide bolted field connections.

PART 3 - EXECUTION

3.1 ERECTION

A. **Framing**. Erect framing true to line, level, plumb, rigid, and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double nutted anchor bolts. Use a non-shrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.

B. **Purlins and Girts**. Provide rake or gable purlins with tight fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.

C. **Bracing**. Provide diagonal rod or angle bracing in roof and sidewalls as indicated.

1. Movement resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer's standards.
2. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or angle bracing will not be required.

D. **Framed Openings**. Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

3.2 ROOFING AND SIDING

A. **General**. Arrange and nest sidelap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.

1. Field cutting of exterior panels by torch is not permitted.
2. Provide weather-seal under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.

B. **Wall Sheets**. Install wall system per manufacturer's requirements. Handle and apply any sealants and backup in accordance with the sealant manufacturer's recommendations.

1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws. Fasten window and door frames with machine screws or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

C. **Sheet Metal Accessories**. Install gutters, downspouts, ventilators, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting. Adjust operating mechanism for precise operation.

D. **Doors and Frames**. Install doors and frames straight, plumb, and level. Securely anchor frames to building structure. Set units with 1/8 inch maximum clearance between door and frame at jambs and head and 3/4 inch maximum between door and floor. Adjust hardware for proper operation.

E. **Thermal Insulation**. Install insulation concurrently with installation of ceiling and wall panels in accordance with manufacturer's directions. Install blankets straight and true in one piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place.

F. **Cleaning and Touch-Up**. Clean component surfaces of matter that could preclude paint bond. Touch up abrasions, marks, skips, or other defects to shop primed surfaces with same type material as shop primer. Coat non-building surfaces in accordance with specification Section 09 90 00, as applicable.

END OF SECTION

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SECTION 14 24 02

LIMITED USE LIMITED APPLICATION (LULA) ELEVATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1. Division 26 Sections for electrical service for elevators to and including disconnect and fused switches at machine room.
2. Division 26 Sections for standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
3. Division 26 Section "Voice and Data Communication Cabling" for telephone service to elevators.
4. Section 03 33 00 - Cast-in-Place Concrete: Concrete for elevator machine foundation, and pit.
5. Section 08 71 00 - Finish Hardware.
6. Section 09 29 00 - Gypsum Drywall: Shaft walls.
7. Section 09 90 00 - Painting: Interior transparent wood finish in cab.

1.2 SUMMARY OF WORK

A. Provide a complete, fully functional LULA elevator in the lobby of the WTP, meeting all current code requirements, as described herein and as shown on the Drawings.

B. The Contractor is responsible for coordination of demolition work related to preparing for the installation of the new elevator. The Contractor is responsible for the new hoistway and machine room.

C. The Contractor shall be responsible to bring power and lighting to the new Elevator Machine Room and the Hoist Room. The Contractor is responsible for installation of Smoke Detector in Elevator and Machine Rooms, and to wire to Elevator Control Panel.

1.3 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings for the elevator system, components and controls, as outlined in Section 01 33 00.
2. Shop drawings shall include point-to-point control wiring diagrams that will be used for the elevator installation.

B. Product Data. Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Provide a complete layout of lift equipment detailing dimensions and clearances as required.

D. Selection Samples. For each finish product specified requiring selection of color or finish, two complete sets of color

1.4 REGULATORY REQUIREMENTS

A. Comply with the following regulations, or any later version incorporated by OBC:

1. American National Standards Institute (ANSI) B-29.2 - Chain Standards for Inverted Tooth (Silent) Chains and Sprockets.

2. American Society of Mechanical Engineers (ASME) A17.1 - Safety Code for Elevators and Escalators.

3. American Society of Mechanical Engineers (ASME) A18.1 - Safety Standard for Platform and Stairway Chair Lifts.

4. CSA B44.1 - Elevator and Escalator Electrical Equipment.

5. CSA B355 - Lifts for Persons with Physical Disabilities.

6. CSA B613 - Private Residence Lifts for Persons with Physical Disabilities.

7. U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".

8. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities.

9. NFPA 70 - National Electric Code.

10. CSA - National Electric Code.

11. Americans with Disabilities Act

1.5 INSPECTIONS AND PERMITS

A. Obtain and pay for all required permits, inspections and fees, including "Permit(s) to Install" and "Elevator Operating Permit".

B. Arrange for and make all required inspections and tests.

C. Turn over all inspection certificates and operating permits to The Owner, upon completion of the Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store, protect and handle materials in accordance with manufacturer's recommendations to prevent damage, soiling or deterioration.

B. Fully protect movable and operating equipment from weather damage.

C. Materials shall not be delivered to the site until areas in which they are to be installed are ready to receive them in their place of final installation.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with local requirements.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install systems under environmental conditions outside manufacturer's absolute limits.

1.8 TRAINING

A. Provide a minimum of four (4) hours of instruction and training for The Owner's staff in the operation and maintenance of the elevators and controls.

1.9 SPECIAL WARRANTY

A. Coverage - this warranty applies to the repair or replacement, at Manufacturer's option, of parts that fail due to defective material or workmanship. Manufacturer may, at its option, provide factory reconditioned parts. This warranty is provided to the Authorized Dealer on behalf of the final purchaser of the product and is not transferable. The Manufacturer's warranty does not cover labor charges for the removal, repair or replacement of warranty parts but such costs may be covered for a period of time by Authorized Dealer's warranty, which is provided to purchaser separately.

1. The manufacturer shall offer a 36-month limited warranty on parts from date of shipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE VENDORS

A. Obtain all elevator equipment through one Vendor. Approved Vendor’s are as follows:

1. Savaria, Brampton, ON, Canada (Basis of Design)

2. Approved Equivalent

2.2 ELEVATOR - GENERAL

A. Work described in this section includes providing equipment, incidental material and labor required for complete, operable roped hydraulic passenger elevator installation. Elevator shall be erected, installed, adjusted, tested and placed in operation by system manufacturer, or manufacturer's authorized installer.

B. Elevators shall be in accordance with the ASME A17.1-B44 and ADA compliant including local codes and regulations except where specified otherwise.

C. Limited Use Limited Application elevator type:

1. Hydraulic
   a. 2:1 roped hydraulic drive.
   b. Duty cycle: normal 30 trips per day, heavy 75 trips per day with a maximum number of start per hour on a standard installation of 15x

D. Limited Use Limited Application elevator shall consist of:

1. Rated Load: 1400 lb (635 kg)
2. Rated Speed: 30 f.p.m. (nominal) (0.15 m/s)
3. Travel: 12 feet. (FF Elevation 972 to FF Elevation 984)
4. Cab Configuration: Enter/exit same side.
5. Car Platform Size: 48” W by 54” D (1219 mm by 1371 mm)
6. Levels Serviced: 2
7. Car Operation: Automatic.
8. Power Supply: 208 Volt, 3 Phase, 30 Amps + 110 Volt, 15 amp, 1 Phase 60 Hz
9. Emergency Power: Battery operation in down direction
10. Controller: PLC
11. Manual Lowering: Outside the hoist way in machine room

E. Elevator Cab Design:

1. Car Enclosure: Steel cab with standard PLAM overlays & stainless steel dropped ceiling and trims.
2. Cab Walls: Laminate Overlay with Stainless Steel Trim.
3. Ceiling Finish: Stainless Steel Drop Down Ceiling with a combination of hidden panel lighting and LED pot lights.
4. Car doors and frames shall be 1 1/2 hour ULC Fire rated and 2 speed horizontally sliding. Car door finish shall be Stainless Steel brushed #4.
5. Handrail: A stainless steel single handrail, with 1-1/2 inch (38 mm) diameter rail shall be located on the control wall of the cab.
6. Carpet Tile: Carpet tile shall be provided for the elevator car floor. Provide carpet tile identical to that tested for the following fire performance characteristics, per test method indicated below, by Underwriters' Laboratories, Inc. (UL) or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet tile with appropriate markings of applicable testing and inspecting organization. Test Method shall be DOC FF 1-70.

F. Automatic Landing Doors

1. Landing doors and frames shall be 1 1/2 hour ULC Fire rated, 2 speed horizontally sliding with concealed mechanical interlock.
   Door finish shall be:
   a. Stainless Steel brushed #4

G. Car Operation:

1. Car Operating Panel shall consist of metal push bottoms with illuminated haloes, tactile identifications, emergency stop/alarm button, on/off key switch and emergency light mounted on a removable stainless steel panel (Type 304 #4 Stainless Steel Finish).

2. Digital floor indicator and directional indicator in cab and at each landing.

3. An ADA hands free phone shall be supplied within car operating panel.

4. Emergency Operation - The car shall be equipped with a battery operated light fixture, emergency battery lowering device and alarm in case of normal building supply failure. The battery shall be the rechargeable type with an automatic recharging system. A manual lowering device shall be located outside the hoistway in the machine room.

H. Fire Service.

1. Phase 1 fire recall service only.

2.3 DRIVE SYSTEM

A. Hydraulic 2:1 roped drive

1. Pumping Unit and Controller: The pumping unit and controller shall be in a separate machine room. The controller and pump unit shall be pre-wired and tested prior to shipment. Pump unit shall incorporate the following features:
   a. Smooth stops at each landing.
   b. Submersible pump and motor.
   c. Adjustable pressure relief valve.
   d. Manually operable down valve to lower lift in the event of an emergency. This valve shall be activated from the machine room.
   e. Gate valve to isolate cylinder from pump unit.
   f. Emergency lowering by battery power from the car control

2. Cylinder and Plunger:
   a. The cylinder shall be constructed of steel pipe of sufficient thickness and suitable safety margin. The top of the cylinder shall be equipped with a cylinder head with an internal guide ring and self-adjusting packing.
   b. The plunger shall be constructed of a solid steel shaft of proper diameter machined true and smooth. The plunger shall be provided with a stop electrically welded to the bottom to prevent the plunger from leaving the cylinder
   c. Cable: Aircraft Cable 2 X 3/8" (10 mm) DIA. Minimum breaking strength of 12,000 lb (5455 kg) each.

3. Guide Yoke: The 2:1 guide yoke assembly shall be supplied with one (1) sheave, guide shoes, bearings and guards.

4. Guide Rails and Brackets: Steel 8 lb per ft guide rails and adjustable brackets shall be used to guide the platform and sling.

5. Motor/Pump: 240 1 Phase or 208 3 Phase,/ 5HP

2.4 LEVELING DEVICE

A. The lift shall be provided with an anti-creep device which will maintain the carriage level within 1/2 inch (12 mm) of each landing.

B. All limit switch and leveling device switches shall be located in a position to be inaccessible to unauthorized persons.

2.5 TERMINAL STOPPING DEVICE

A. Normal terminal stopping devices shall be provided at top and bottom of runway to stop the car positively and automatically.

2.6 WIRING

A. All wiring and electrical connections shall comply with applicable codes. Insulated wiring shall have flame-retardant and moisture-proof outer covering and shall be run in conduit or electrical wire ways if located outside the unit enclosure. Quick disconnect harnesses shall be used when possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until hoistway and machine room has been properly prepared.

B. Site dimensions shall be taken to verify that tolerances and clearances have been maintained and meet local regulations.
If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. The following preparatory work to receive the lifts specified in this section is part of the work of other sections:
   1. Permanent 208 VAC, 30 amp three phase power to operate lift to be provided from a lockable fused/cartridge type disconnect switch with auxiliary contacts for battery operation. 110 VAC, 15 amp single phase power to operate the lighting circuit. Refer to drawings for permanent power specifications and location of disconnects.
   2. Provide a plumb and square hoistway with smooth interior surfaces, including fascias or furring of the hoistway interior.
   3. Provide rough openings per lift contractor's shop drawings.
   4. Provide substantial, level pit floor slab as indicated on the lift contractor's shop drawings.

3.3 ELEVATOR INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install the components of the elevator system that are required and that are required by jurisdictional authorities to license the elevator.

A. Trained employees of the elevator contractor shall perform installation work.

B. Adjust elevator for proper operation and clean unit thoroughly.

C. Instruct users in operating procedures and owner's maintenance person in trouble-shooting and maintenance procedures.

3.4 LIFT INSTALLATION

A. Install all the components of the lift system that are specified in this section to be provided, and that are required by jurisdictional authorities to license the lift.

B. Trained employees of the lift contractor shall perform all installation work of this section.

C. Adjust lift for proper operation and clean unit thoroughly.

D. Instruct users in operation procedures and Owner's maintenance person in trouble-shooting and maintenance procedures.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope**

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to provide a complete plumbing system as shown on the drawings and specified.

B. **Coordination**

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with plumbing, general provisions.

C. **Related Sections**

1. Division 1, General Requirements.
2. Section 22 13 16, Plumbing Piping.
3. Section 22 13 19, Plumbing Specialties.
4. Section 22 14 29, Sump Pumps.
5. Section 22 33 00, Electric Domestic Water Heaters.
6. Section 22 45 00, Emergency Plumbing Fixtures.
7. Section 23 05 29, HVAC and Plumbing Piping and Equipment Hangers and Supports.
8. Section 23 07 00, HVAC and Plumbing Insulation.

1.3 QUALITY ASSURANCE

A. **Reference Standards.** Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. American Water Works Association (AWWA).
4. Plumbing and Drainage Institute (P.D.I.).

B. **Regulatory Requirements**

1. Comply with applicable provisions of regulatory agencies below and others having jurisdiction:

    a. Ohio Building Code.
    b. Ohio Plumbing Code.

2. Code provisions supersede the Contract Documents.

3. Notify the ENGINEER of conflicts between code provisions and the Contract Documents prior to Shop Drawing submittals.

4. Permits. The CONTRACTOR shall arrange for all inspections required by the Plumbing Inspector, and shall inform the ENGINEER of all pending inspection schedules.

C. **Steel Support Welding:** Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

D. **Steel Pipe Welding:** Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. **Electrical Characteristics for Plumbing Equipment:** Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.4 **SUBMITTALS**

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Shop Drawings shall include manufacturer’s literature, specifications, installation diagrams, including isometrics and engineering data.
2. Project Record Documents: Prepare and submit comprehensive record drawings for the principal plumbing work performed under this Section.

B. **Product Data.** Submit data on new or replacement equipment and parts.

C. **Product Data.** For the following:

1. Transition fittings.
2. Dielectric fittings.

3. Mechanical sleeve seals.
4. Escutcheons.

D. **Welding certificates.**

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

1. Check with manufacturers and vendors as to the physical sizes of equipment to ensure that it will fit in the spaces assigned and instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 DEFINITIONS

A. **Finished Spaces.** Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. **Exposed, Interior Installations.** Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. **Exposed, Exterior Installations.** Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. **Concealed, Interior Installations.** Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. **Concealed, Exterior Installations.** Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.

2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Manufacturers**: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. **Refer to individual Division 22** piping Sections for pipe, tube, and fitting materials and joining methods.

B. **Pipe Threads:** ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. **Refer to individual Division 22** piping Sections for special joining materials not listed below.

B. **Pipe-Flange Gasket Materials.** Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. **Flange Bolts and Nuts.** ASME B18.2.1, carbon steel, unless otherwise indicated.

D. **Plastic, Pipe-Flange Gasket, Bolts, and Nuts.** Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. **Solder Filler Metals.** ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. **Brazing Filler Metals.** AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. **Welding Filler Metals.** Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. **Solvent Cements for Joining Plastic Piping**

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. **Fiberglass Pipe Adhesive.** As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. **AWWA Transition Couplings.** Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.
g. Or equal.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. **Plastic-to-Metal Transition Fittings**. CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers

a. Eslon Thermoplastics.
b. Or equal.

C. **Plastic-to-Metal Transition Adaptors**. One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers

a. Thompson Plastics, Inc.
b. Or equal.

D. **Plastic-to-Metal Transition Unions.** MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.
c. Or equal.

E. **Flexible Transition Couplings for Underground Nonpressure Drainage Piping.** ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.
e. Or equal.

2.5 DIELECTRIC FITTINGS

A. **Description.** Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. **Insulating Material.** Suitable for system fluid, pressure, and temperature.

C. **Dielectric Unions.** Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.
h. Or equal.

D. **Dielectric Flanges.** Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Epco Sales, Inc.
    d. Watts Industries, Inc.; Water Products Div.
    e. Or equal.

E. **Dielectric-Flange Kits.** Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.
    e. Or equal.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. **Dielectric Couplings.** Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

    a. Calpico, Inc.
    b. Lochinvar Corp.
    c. Or equal.

G. **Dielectric Nipples.** Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers

    a. Perfection Corp.
    b. Precision Plumbing Products, Inc.
    c. Sioux Chief Manufacturing Co., Inc.
    d. Victaulic Co. of America.
    e. Or equal.

2.6 MECHANICAL SLEEVE SEALS

A. **Description.** Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Or equal.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. **Galvanized-Steel Sheet.** 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. **Steel Pipe.** ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. **Cast Iron.** Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. **Stack Sleeve Fittings.** Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. **Molded PVC.** Permanent, with nailing flange for attaching to wooden forms.

F. **PVC Pipe.** ASTM D 1785, Schedule 40.

G. **Molded PE.** Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. **Description.** Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. **One-Piece, Deep-Pattern Type.** Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. **One-Piece,** Cast-**Brass Type.** With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. **Split-Casting, Cast-Brass Type.** With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

E. **One-Piece, Stamped-Steel Type.** With set screw or spring clips and chrome-plated finish.

F. **Split-Plate, Stamped-Steel Type.** With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. **One-Piece, Floor-Plate Type.** Cast-iron floor plate.

H. **Split-Casting, Floor-Plate Type.** Cast brass with concealed hinge and set screw.

2.9 GROUT

A. **Description.** ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics. Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the work. CONTRACTOR shall correct any unsatisfactory conditions before proceeding with the work.

B. **Verification of Site Conditions**. CONTRACTOR shall examine the site(s) and existing facilities and compare them with the Contract Documents with respect to the conditions of the premises, location of or connection of existing facilities and any obstructions which may be encountered and conduct his work to minimize disruption to existing conditions.

3.2 PLUMBING DEMOLITION

A. Refer to Division 1 Section "Cutting and Patching" and Division 2 for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
    j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping. Use the following:

    a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
    g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
    h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
    j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.

k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Flashing and Sheet Metal" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

Q. **Aboveground, Exterior-Wall Pipe Penetrations.** Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. **Underground, Exterior-Wall Pipe Penetrations.** Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. **Fire-Barrier Penetrations.** Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. **Soldered Joints.** Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. **Brazed Joints.** Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. **Threaded Joints**. Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. **Welded Joints**. Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. **Flanged Joints.** Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. **Plastic Piping Solvent-Cement Joints.** Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. **Plastic Pressure Piping Gasketed Joints.** Join according to ASTM D 3139.

K. **Plastic Nonpressure Piping Gasketed Joints.** Join according to ASTM D 3212.

L. **PE Piping Heat-Fusion Joints.** Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. **Fiberglass Bonded Joints.** Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.7 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 9 Section "Painting".

B. **Damage and Touchup.** Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

A. **Concrete Bases.** Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Miscellaneous Metals" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. **Field Welding.** Comply with AWS D1.1.

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.11 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.12 FIELD QUALITY CONTROL

A. **Performance.** All work shall be done by a firm experienced and properly manned and tooled in the work specified.

B. Installation with Division 26 requirements.

END OF SECTION

SECTION 22 05 53

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. **Related Sections.** This section is Division 1 Basic Mechanical Materials and Methods section, and is part of each Division 22 or Division 23 section making reference to identification devices specified herein.

C. **Factory Fabrication.** Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division 22 or 23 sections.

D. **Other Mechanical Identification.** Refer to other Division 22 or 23 sections for identification requirements at central station mechanical control center; not work of this section.

E. **Electrical Identification.** Refer to Division 26 sections for identification requirements of electrical work; not work of this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to construct the project in accordance with the plans and as specified herein.

B. **The Contractor shall provide** the labor, tools, equipment, and materials necessary to perform the work in accordance with the plans and as specified herein.

C. **Types.** Types of identification devices specified in this section include the following:

1. Painted identification materials.
2. Plastic pipe markers.
3. Plastic tape.
4. Underground-type plastic line marker.
5. Plastic duct markers.
6. Valve tags.
7. Valve schedule frames.
8. Engraved plastic laminate signs.
9. Plastic equipment markers.
10. Plasticized tags.

1.3 **QUALITY ASSURANCE**

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. American National Standards Institute (ANSI) Standards. Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. **Manufacturer Qualifications**. Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 **SUBMITTALS**

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Product Data**. Submit manufacturer's technical product data and installation instructions for each identification material and device required.

C. **Samples**. Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

D. **Schedules**. Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut off and similar special uses, by special "flags," in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

E. **Maintenance Data**. Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

1.5 **JOB CONDITIONS** (Not Used)

1.6 **DELIVERY, STORAGE, AND HANDLING** (Not Used)

1.7 **SPECIAL WARRANTY** (Not Used)

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Manufacturer**. Subject to compliance with requirements, provide mechanical identification materials of one of the following:

1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. **General**. Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 or 23 sections. Where more than single type is specified for application, selection is Installer's option, but Installer shall provide single selection for each product category.

2.3 PLASTIC PIPE MARKERS

A. **Snap-On Type**. Provide manufacturer's standard preprinted, semirigid snap-on, color coded pipe markers, complying with ANSI A13.1

B. **Pressure-Sensitive Type**. Provide manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1

C. **Insulation**. Furnish 1-inch-thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees Fahrenheit (º F.) or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.

D. **Small Pipes**. For external diameters less than 6 inches (including insulation if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pretensioned semirigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.

E. **Large Pipes**. For external diameters of 6 inches and larger (including insulation if any), provide either full band or strip type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 1-1/2 inch wide; full circle at both ends of pipe marker, tape lapped 3 inches.
3. Strapped-to-pipe (or insulation) application of semirigid type, with manufacturer's standard stainless steel bands.

F. **Lettering**. Manufacturer's standard preprinted nomenclature which best describes piping system in each instance, as selected by Engineer/Architect in cases of variance with names as shown or specified.

G. **Lettering.** Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.4 PLASTIC TAPE

A. **General**. Provide manufacturer's standard color coded pressure sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. **Width**. Provide 1-1/2-inch-wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 inches, 2-1/2-inch-wide tape for larger pipes.

C. **Color**. Comply with ANSI A13.1, except where another color selection is indicated.

2.5 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. **General**. Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6 inches wide by 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.

1. Provide multiple-ply tape consisting of solid aluminum foil core between two layers of plastic tape.

2.6 PLASTIC EQUIPMENT MARKERS

A. **General**. Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Green. Cooling equipment and components.
2. Yellow. Heating equipment and components.
3. Yellow/Green. Combination cooling and heating equipment and components.
4. Brown. Energy reclamation equipment and components.

5. Blue. Equipment and components that do not meet any of the above criteria.
6. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. **Nomenclature**. Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. **Size**. Provide approximate 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.7 PLASTICIZED TAGS

A. **General**. Manufacturer's standard preprinted or partially preprinted accident prevention tags, of plasticized card stock with matte finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate preprinted wording including large size primary wording (as examples: DANGER, CAUTION, DO NOT OPERATE).

2.8 LETTERING AND GRAPHICS

A. **General**. Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

B. **Multiple Systems**. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. **Coordination**. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

A. **General**. Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Stenciled markers, including color coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2 inches beyond ends of lettering.
2. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot noninsulated pipes.
3. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.

B. **Location.** Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior nonconcealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter nonaccessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.3 UNDERGROUND PIPING IDENTIFICATION

A. **General**. During back filling/top soiling of exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6 inches to 8 inches below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.4 MECHANICAL EQUIPMENT IDENTIFICATION

A. **General**. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gauges, thermometers and similar units.
3. Fuel burning units including boilers, furnaces, heaters, stills, and absorption units.
4. Pumps, compressors, chillers, condensers, and similar motor driven units.
5. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
6. Fans, blowers, primary balancing dampers and mixing boxes.
7. Packaged HVAC central station or zone type units.
8. Tanks and pressure vessels.
9. Strainers, filters, humidifiers, water treatment systems and similar equipment.

B. **Optional Sign Types**. Where lettering larger than 1 inch height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at installer's option.

C. **Lettering Size**. Minimum 1/4-inch-high lettering for name of unit where viewing distance is less than 2'-0", 1/2 inch high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

D. **Text of Signs**. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. **Optional Use of Plasticized Tags**. At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

F. **Nonoccupied Spaces.** Operational valves and similar minor equipment items located in nonoccupied spaces (including machine rooms) may, at installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

3.5 ADJUSTING AND CLEANING

A. **Adjusting**. Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. **Cleaning**. Clean face of identification devices, and glass frames of valve charts.

3.6 EXTRA STOCK

A. **Furnish minimum of 5 percent extra stock** of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

SECTION 22 07 19

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. **Related Sections**. The following sections contain requirements that relate to this section.

1. Refer to Section 22 05 29, "Supports and Anchors," for protection saddles, protection shields, and thermal hanger shields; not work of this section.
2. Refer to Section 22 05 53, "Mechanical Identification," for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and material necessary to perform mechanical insulation work in accordance with the plans and as specified herein.

B. **Types.** Types of mechanical insulation specified in this section include the following:

1. Piping Systems Insulation.

    a. Fiberglass.
    b. Cellular glass.
    c. Calcium silicate.
    d. Flexible unicellular.

2. Equipment Insulation.

    a. Fiberglass.
    b. Calcium silicate.
    c. Cellular.
    d. Flexible unicellular.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all mechanical insulation work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Manufacturer's Qualifications**. Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.

C. **Installer's Qualifications**. Firm with at least 5 years' successful installation experience on projects with mechanical insulations similar to that required for this project.

D. **Flame/Smoke Ratings**. Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by American Society for Testing and Materials (ASTM) E 84 (National Fire Protection Association [NFPA] 255) method.

1. Exception. Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
2. Exception. Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Product Data**. Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

C. **Maintenance Data**. Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate with all other trades to prevent delays, errors, or omissions.

B. **Climatic Conditions**. Do not perform installation when ambient conditions would cause damage to the materials, jacketing, or otherwise violate manufacturer's installation requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery.** Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. **Protection and Damage.** Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove wet or damaged insulation from project site.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **PRODUCTS/MATERIALS**

A. **Piping Insulation**

1. Fiberglass Piping Insulation. ASTM C 547, Class 1 for use up to 450 degrees Fahrenheit (° F.); Class 2 for use up to 650° F. and Class 3 for use up to 1,200° F.
2. Cellular Glass Piping Insulation. ASTM C 552, Type II, Class 2.
3. Calcium Silicate Piping Insulation. ASTM C 533, Type I for use up to 1,200° F.; Type II for use up to 1,800° F.

2.2 **COMPONENTS**

A. **Jacketing Material for Equipment Insulation**. Provide presized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at installer's option, except as otherwise indicated.

2.3 **ACCESSORIES**

A. **Insulation Accessories**. Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

B. **Insulation Compounds**. Provide cements, tapes, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

C. **Equipment Insulation**

1. Rigid Fiberglass Equipment Insulation. ASTM C 612, Class 2.
2. Flexible Fiberglass Equipment Insulation. ASTM C 553, Type I, Class B-6 (3 pounds per cubic foot density).
3. Calcium Silicate Equipment Insulation. ASTM C 533, Type I, Block, for use to 1,200° F.; Type II, Block, for use up to 1,800° F.
4. Cellular Glass Equipment Insulation. ASTM C 552, Type I.

2.4 **SOURCE QUALITY CONTROL**

A. **Manufacturer**. Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed Corp.
3. Knauf Fiber Glass GmbH.
4. Manville Products Corp.
5. Owens-Corning Fiberglas Corp.
6. Pittsburgh Corning Corp.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine areas and conditions** under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 ERECTION/INSTALLATION/APPLICATION

A. **Piping Insulation**

1. General. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
2. Sequence of Work. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
3. Surfaces. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
4. Joints. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
5. Vapor Barrier. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
6. Valves and Fittings. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at installer's option) except where specific form or type is indicated.
7. Structural Penetrations. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
8. Hangers. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3-inch-wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch-wide vapor barrier tape or band.
9. Copper Pipe. Insulation used in below grade and outdoor installations shall be free from nitrites and not contain more than 0.2 percent ammonia.
10. Outdoor Insulation. Insulation of Piping Exposed to Weather. Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by the manufacturer.

B. **Plumbing Piping Application**

1. Insulation Omitted. Omit insulation on chrome plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and preinsulated equipment. Plumbing piping (Hot and

Cold Potable) shall be completely insulated including all fittings, valves, unions, etc. when installed in Class 1 Division 1, Group D rated areas**.**

2. Cold Piping.

a. Application Requirements. Insulate the following cold plumbing piping systems:

1) Potable cold water piping.
2) Potable chilled water piping.
3) Plumbing vents within 6 lineal feet of roof outlet.

b. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

1) Flexible Unicellular. 1/2-inch thickness.

3. Hot Piping.

a. Application Requirements. Insulate the following hot plumbing piping systems:

1) Potable hot water piping.
2) Potable hot water recirculating piping.
3) Hot drain piping.

b. Insulate each piping system specified above with one of the following types and thicknesses of insulation.

1) Flexible Unicellular. 1inch for pipe sizes up to 2 inches. 1-1/2 inches for pipe sizes larger.

4. Storm Drains.

a. Application Requirements. Insulate the following storm drain piping systems:

1) All horizontal roof drain piping
2) The first 2 feet of vertical roof drain piping at all transitions from horizontal .
3) All roof drain piping within 6 lineal feet of roof drain.

b. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

1) Flexible Unicellular. 1/2-inch thickness.

C. **Equipment Insulation**

1. General. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with

recognized industry practices to ensure that insulation serves intended purpose.

2. Surfaces. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
3. Vapor Barrier. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.
4. Temperature. Do not apply insulation to equipment, breechings, or stacks while hot.
5. Joints. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
6. Cement. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
7. Jacket. Cover insulated surfaces with all service jacketing neatly fitted and firmly secured. Lap seams at least 2 inches. Apply over vapor barrier where applicable.
8. Omit Insulation. American Society of Mechanical Engineers (ASME) stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
9. Removable Insulation. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
10. Equipment Exposed to Weather. Protect outdoor insulation from weather by installation of weather barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

D. **Equipment Insulation Application**

1. Cold Equipment (Below Ambient Temperature).

a. Application Requirements. Insulate the following cold equipment:

1) Cold water storage tanks.

b. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:

1) 1-1/2 inches Flexible Unicellular.

3.3 REPAIR/RESTORATION

A. **General.** Repair damaged sections of existing mechanical insulation, either previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

B. **Replacement.** Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

3.4 PROTECTION

A. **Protection**. Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

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SECTION 22 13 16

PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope**

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install plumbing piping.

B. **Coordination**

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with plumbing piping.

C. **Related Sections**

1. Division 1, General Requirements.
2. Section 22 05 00, Common Work Results for Plumbing.
3. Section 22 13 19, Plumbing Specialties.
4. Section 22 14 29, Sump Pumps.
5. Section 22 33 00, Electric Domestic Water Heaters.
6. Section 22 45 00, Emergency Plumbing Fixtures.
7. Section 23 05 29, HVAC and Plumbing Piping and Equipment Hangers and Supports.
8. Section 23 07 00, HVAC and Plumbing Insulation.

1.3 PERFORMANCE REQUIREMENTS

B. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Storm Drainage Piping: 10-foot head of water.

1.4 QUALITY ASSURANCE

A. **Reference Standards.** Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. Ohio Building Code.
2. Ohio Plumbing Code.

1.5 **SUBMITTALS**

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Product Data: For the following:

a. Pipes and Fittings.
b. Valves and Specialties.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

1. All material labels or tags will be intact and legible.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Copper Water Tube**

1. Tube

a. Reference: ANSI H23.1.
b. Type: K or L.
c. Temper: Hard-drawn or soft annealed.

2. Fittings

a. Reference: ANSI B16.22.
b. Reference: ANSI B16.26.
c. Reference: ANSI B16.18.

3. Joints

a. Sweat

1) Solder Metal: ASTM B 32 Type 95-5TA.
2) Flux: FS 0-F-506, Type 1.

b. Flanged

1) Flanges: ANSI B16.24, 150 lb. Class.
2) Gaskets: Red rubber, ASTM D1330, Grade 1, 1/8-inch thick.
3) Nuts and Bolts: ASTM A 307.

4. Unions

a. Reference: FS WW-U-516.
b. Material: Bronze.
c. Rating: 250 pound W.O.G.

B. **Waste, Vent and Storm Drainage Piping**

1. Cast Iron Soil Pipe and Fittings

a. Pipe and Fittings: ASTM A 74.
b. Weight: Service weight.
c. Joints

1) Caulked

a) Lead: FS QQ-C-40, Type I, Grade AA.
b) Jute Packing: FS HH-P-117, Type I.

2) Compression

a) Gasket: Rubber, ASTM C 564.
b) Lubricant: As recommended by pipe manufacturer.

2. Hubless Cast Iron

a. Pipe and Fittings: CISPI Standard No. 301 or ASTM A 888.
b. Joints: CISPI Standard No. 310.

3. Steel Pipe and Fittings

a. Pipe: ASTM A 53.
b. Weight: Schedule 40.
c. Finish: Galvanized.
d. Fittings: ASME B 16.9 threaded so as to allow 1/8-inch or ¼-inch per foot grade, as needed.

4. No-hub Couplings

a. Product and Manufacturer: Provide hubless couplings manufactured by one of the following:

1) Anaco, Husky Series 4000.
2) Clampall, Heavy Duty Type 304.
3) Or approved equal.

b. Provide as optional method for connecting hubless drain lines of dissimilar materials.

C. **Dielectric Couplings**

1. Type: Union or flange.
2. Product and Manufacturer: Provide dielectric couplings and manufactured by one of the following:

    a. Watts Regulatory Company.
    b. Epco Sales Incorporated.
    c. Or approved equal.

3. Ratings

    a. Unions: 250 psi, ANSI B16.39.
    b. Flanges: 175 psi, ANSI B16.42 (iron) ANSI B16.24 (Bronze).

D. **Transition Couplings**

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Nonpressure Transition Couplings

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company; a division of MCP Industries, Inc.
        3) Or approved equal.

    b. Standard: ASTM C 1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. **Bronze Body Gate Valves**

1. Product and Manufacturer: Provide valves as manufactured by one of the following:

    a. Stockham Valves and Fittings, Fig. No. B-124.
    b. Lunkenheimer Company, Fig. No. 3155.
    c. Or approved equal.

2. Type: Rising stem, union bonnet solid wedge disc.

    a. Materials: Brass and bronze.
    b. Rating: 150 lb. SWP.
    c. End Connections: Solder joint.

F. **Bronze Body Gate Valve, Hose End**

1. Product and Manufacturer: Provide valves manufactured by one of the following:

    a. Jenkins Brothers, Fig. No. 372.
    b. Walworth Col, Fig. No. 24.
    c. Or approved equal.

2. Type: Non-rising stem, solid wedge inside screw, hose outlet.
3. Materials: Brass and bronze

    a. Rating: 200 psi non-shock cold water.
    b. End Connection: Screwed end with solder adapter.

G. **Bronze Body Check Values**

1. Product and Manufacturer: Provide valve manufactured by one of the following:

    a. Stockham Valves and Fittings, Fig. No. B-309.
    b. Lukenheimer Company, Fig. No. 2145.
    c. Or approved equal.

2. Type: Swing, regrinding bronze disc, screw-in cap.

    a. Materials: Brass and bronze.
    b. Rating: 200 lb. SWP.
    c. End Connections: Solder joint.

H. **Bronze Body Globe Valves**

1. Product and Manufacturer: Provide valves manufactured by one of the following:

    a. Stockham Valves and Fittings, Fig. No. B-24.
    b. Lukenheimer Company, Fig. No. 126.
    c. Or approved equal.

2. Type: Composition disc, union bonnet.
3. Materials: Brass and bronze.
4. Rating: 150 lb. SWP.
5. End Connections: Solder joint.

I. **Bronze Body Ball Valves**

1. Product and Manufacturer: Provide valves manufactured by one of the following:

    a. Watts Regulator Company No. B-6001.
    b. Jenkins Bros. Fig. 902T.
    c. Or approved equal.

2. Type: Non-blowout stem, adjustable packing gland, quarter turn, full port ball valve.
3. Materials

    a. Body: Cast bronze.
    b. Ball: Chrome plated brass or stainless steel.
    c. Packing and Seats: Teflon

4. Rating: 400 psi WOG.
5. End Connections: Solder End.

J. **Gas Service Piping, 0.5 PSIG to 5 PSIG**

1. NPS 1 and Smaller

    a. Pipe: Steel pipe, ASTM A53/A53M, Type E or S, Grade B; Schedule 40, black.
    b. Fittings: Malleable-iron, threaded, ASMEB16.3, Class 150.
    c. Joints: Threaded, ASMEB16.39, Class 150.

2. NPS 1 ¼ to NPS 2 ½

    a. Pipe: Steel pipe, ASTM A53, Type E or S, Grade B, Schedule 40, Black.
    b. Fittings: Welded, ASME B 16.9, wrought steel or ASME B16.11 forged steel.
    c. Joints: Welded.

3. Steel flanges and flanged fittings: ASME B16.5.

    a. Joint compound and tape: Suitable for natural gas.
    b. Gasket Material: Thickness, material, and type suitable for natural gas.
    c. Furnish pipe and fittings with factory-applied, corrosion-resistant poly-ethylene coating for use in corrosive atmosphere.

K. **Gas Service Valves**

1. Valves, NPS 2 AND Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
2. Valves, NPS 2-1/2 AND Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B 16.24 for copper and copper-alloy flang-es.
3. Appliance Connector Valves: ANSI Z21.15 and IAS listed.
4. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.
5. Gas Valves, NPS 2 and Smaller: ASME B16.33 and IAS-listed bronze body and 125-psig pressure rating.
6. Plug Valves, NPS 2-1/2 and Larger: ASME B16.38 AND mss sp-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.

7. General-Duty Valves, NPS 2/1/2 and Larger: MSS SP-70, ASME B16.38, cast-iron body gate valves, OS&Y type with solid wedge, suitable for fuel gas service, with "WOG" indicated on valve body, and 125-psig pressure rating.
8. Gas Valve Applications

    a. Appliance Shutoff Valves for Pressure 0.5 psig or Less: Appliance connector valve or gas stop.
    b. Appliance Shutoff Valves for Pressure 0.5 to 2 psig: Gas stop or gas valve.
    c. Piping Line Valves, NPS 2 and Smaller: Gas valve.
    d. Piping Line Valves, NPS 2-1/2 and Larger: Plug valve or general-duty valve.

L. **Y-Pattern Strainers**

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

M. **Basket Strainers**

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

N. **T-Pattern Strainers**

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

O. **Weatherproof Vent Cap.** Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

P. **General Requirements for Metallic Valves, NPS 2 and Smaller.** Comply with ASME B16.33.

1. CWP Rating: 125 pgig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

Q. **General Requirements for Metallic Valves, NPS 2-1/2 and Larger.** Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

R. **Bronze Plug Valves.** MSS SP-78.

1. Manufacturers:

    a. Lee Brass Company.
    b. McDonald, A. Y. Mfg. Co.
    c. Or approved equal.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.=

S. **Gas Pressure Regulators General Requirements**

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

T. **Line Gas Pressure Regulators.** Comply with ANSI Z21.80.

1. Manufacturers

    a. Actaris.
    b. American Meter Company.
    c. Eclipse Combustion, Inc.

d. Invensys.
e. Or approved equal.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 20 psig.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. All water piping 2½ -inches and smaller, run within the interior of a building, shall be hard-drawn copper type "L" with solder joints and connections.

B. All underground water piping 3-inches and smaller shall be soft annealed copper type "K" with soldered joints and connections.

C. All exposed water piping and valves to plumbing fixtures shall be chrome-plated brass, unless otherwise specified.

D. All valves for copper or brass piping shall be bronze bodied unless otherwise specified.

E. All exposed gravity waste, vent and roof drainage piping run within the interior of the building shall be hubless cast iron or threaded galvanized steel. Concealed gravity soil, waste and vent piping in chases may be threaded galvanized steel or hubless cast iron.

F. All underground soil, waste and storm drainage piping within the building shall be service weight cast iron with gasketed or caulked joints.

G. Underground natural-gas piping shall be steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

H. Above ground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

I. Indoor gas Piping Schedule for System Pressures More than 0.5 psig and less than 5 psig.

1. Aboveground, branch piping NPS 3 and smaller shall be the following:

a. Steel pipe with malleable-iron fittings and threaded joints.

2. Aboveground, distribution piping shall be the following:

a. Steel pipe with malleable-iron fittings and threaded joints.

J. Indoor Gas Piping Schedule for System Pressures more than 5 psig.

1. Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.
2. Aboveground, distribution piping shall be the following:

a. Steel pipe with steel welding fittings and welded joints.

3.2 VALVE APPLICATIONS

A. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use gate, or ball.
2. Throttling Duty: Use globe, or ball.
3. Drain Duty: Hose-end drain valves.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install domestic water service piping to exterior water distribution piping in sizes and locations indicated.

C. Install domestic water piping with 1/32-inch-per-foot (¼ percent) slope downward toward drain valve.

D. Install cast-iron soil pipe and cast-iron soil pipe fittings according to CISPI “Cast Iron Soil Pipe and Fittings Handbook, Volume I,” Chapter IV, “Installation of Cast Iron Soil Pipe and Fittings.”

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

G. Make changes in direction for sanitary, storm, and vent piping using appropriate Y branches, Y branches with 1/8 bends, and long-sweep 1/4, 1/5, 1/6, 1/8, and 1/16 bends. Sanitary tees and short-sweep quarter bends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical. Use long-turn double Y-branch and 1/8-bend fittings where two fixtures are installed back-to-back or side-by-side and have a common drain. Straight tees, elbows and crosses may be used on vent lines. Make no change in direction of flow greater than 90 degrees. Where different sizes of drainage pipes and fittings are connected, use proper size standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

H. Install sanitary, storm and vent piping at the following minimum slopes, except where another slope is indicated:

1. Sanitary and Storm Building Drain: ¼-inch per foot (2 percent) for piping 3-inches and smaller; 1/8-inch per foot (1 percent) for piping 4-inches and larger.
2. Horizontal Sanitary and Storm Drainage Piping: 1/8-inch per foot (1 percent).
3. Vent Piping: 1/8-inch per foot (1 percent).

I. **Outdoor Gas Piping Installation**

1. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
2. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 2 for excavating, trenching, and backfilling.

    a. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

3. Steel Piping with Protective Coating:

    a. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

4. Install fittings for changes in direction and branch connections.
5. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

    a. Install steel pipe for sleeves smaller than 6 inches in diameter.
    b. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

6. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
7. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.

Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

J. **Indoor Gas piping installation**

1. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
2. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
3. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
7. Locate valves for easy access.
8. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
9. Install piping free of sags and bends.
10. Install fittings for changes in direction and branch connections.
11. Install escutcheons at penetrations of interior walls, ceilings, and floors.

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    d. Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
    e. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    f. Piping in Equipment Rooms: One-piece, cast-brass type.

12. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

    a. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

13. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
14. Connect branch piping from top or side of horizontal piping.

15. Install unions in pipes NPS 3 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
16. Do not use natural-gas piping as grounding electrode.
17. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
18. Install pressure upstream and downstream from each line regulator.

K. **Valve Installation**

1. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
2. Install underground valves with valve boxes.
3. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

L. **Piping Joint Construction**

1. Ream ends of pipes and tubes and remove burrs.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Threaded Joints

    a. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
    b. Cut threads full and clean using sharp dies.
    c. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
    d. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
    e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

4. Welded Joints

    a. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
    b. Bevel plain ends of steel pipe.
    c. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

5. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
6. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.4 HANGERS AND SUPPORTS INSTALLATION

A. Hangers and support devices are specified in Section 23 05 29 “HVAC and Plumbing Piping and Equipment Hangers and Supports.”

B. Install hangers for horizontal piping with following maximum spacing and minimum rod sizes:

Nom. Pipe Size (Inches)	Steel Pipe Max. Span (Feet)	Copper Tube Max. Span (Feet)	Min. Rod Diameter (Inches)
Up to ¾	7	5	3/8
1	7	6	3/8
1-1/4	7	7	3/8
1-1/2	9	8	3/8
2	10	8	3/8
2-1/2 & Larger	11	9	½

C. Support vertical steel pipe and copper tube at each floor.

D. Install pipe stands for roof mounted gas piping per manufacturer's recommendations, but not to exceed 10 feet centers depending on the load. Each pipe stand shall be properly elevated to even load weight at all pipe stands.

3.5 CONNECTIONS

A. **Supply Runouts to Fixtures.** Install hot- and cold-water supply piping runouts to sizes indicated, but not smaller than required by plumbing code to fixtures.

B. **Drainage Runouts to Fixtures.** Provide drainage and vent piping runouts, with approved trap, sizes indicated, but not smaller than required by plumbing code, to plumbing fixtures and drains.

C. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

D. Unions shall be provided for all screwed piping at connections to equipment on each side of non-flanged valves and at convenient locations to permit disassembly of piping.

E. All connections between ferrous and non-ferrous piping materials shall be made with dielectric couplings.

F. Care shall be taken so as not to leave tool marks or abrasions on plated, polished or soft metal piping.

G. Wherever changes in sizes of piping occur, changes shall be made with reducing fittings. The use of bushings is not permitted unless otherwise shown.

H. **Gas Piping Connections**

1. Coordinate piping installations and specialty arrangements with schematics on Drawings. If Drawings are explicit enough, these requirements may be reduced or omitted.
2. Connect to utility's gas main according to utility's procedures and requirements.
3. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
4. Install piping adjacent to appliances to allow service and maintenance of appliances.

5. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
6. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.6 FIELD QUALITY CONTROL

A. Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until has been inspected and approved by the authority having jurisdiction.
2. During progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to time inspection must be made. Perform tests specified below in presence of the plumbing official.

    a. Roughing-In Inspection: Arrange for inspection of piping system before concealed or closed-in after system roughing-in and prior to setting fixtures.
    b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.

3. Re-inspections: When a plumbing official finds that piping system will not pass test or inspection, make required corrections and arrange for re-inspection by the plumbing official.

B. Test water distribution piping as follows:

1. Test for leaks and defects in new water distribution piping systems. IF testing is performed in segments, submit separate report for each test, complete with diagram of portion of system tested.
2. Leave uncovered and unconcealed in new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved for testing.
3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.

C. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping**,** except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

D. Inspect drainage piping as follows:

1. Do not enclose, cover or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During progress of installation, notify the plumbing official having jurisdiction at least 24 hours prior to time such inspection must be made. Perform tests specified below in presence of the plumbing official.
    a. Roughing-In Inspection: Arrange for inspection of piping system after system roughing-in, before concealing, and prior to setting fixtures.
    b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.

3. Re-inspections: Make required corrections and arrange for reinspection by plumbing official when piping system fails to pass test or inspection.

E. **Drainage and Vent Piping System Tests.** Test drainage and vent systems according to procedures of authority having jurisdiction or, in absence of published procedure, as follows:

1. Test for leaks and defects in new drainage and vent piping system. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.

F. Tests and Inspect Gas Piping.

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
2. Natural-gas piping will be considered defective if it does not pass tests and inspections.
3. Prepare test and inspection reports.

3.7 CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    c. Drain system or part thereof of previous solution and refill with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    d. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    e. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

E. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

F. Prepare and submit reports of purging and disinfecting activities.

3.8 COMMISSIONING

A. **Fill Water Systems.** Check compression tanks to determine that they are not air bound and that system is completely full of water.

B. Before operating systems perform these steps:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to full open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping systems and plugs used for temporary sealing of piping during installation.

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

D. Check plumbing specialties and verify proper settings, adjustments, and operation.

END OF SECTION

SECTION 22 13 19

PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope**

1. CONTRACTOR shall provide all labor, materials and incidentals as shown, and required to furnish and install the plumbing specialties as specified herein.

B. **Coordination**

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the plumbing specialties.

C. **Related Sections**

1. Division 1, General Requirements.
2. Section 22 05 00, Common Work Results for Plumbing.
3. Section 22 13 16, Plumbing Piping.
4. Section 22 14 29, Sump Pumps.
5. Section 22 33 00, Electric Domestic Water Heaters.
6. Section 22 45 00, Emergency Plumbing Fixtures.
7. Section 23 05 29, HVAC and Plumbing Piping and Equipment Hangers and Supports.
8. Section 23 07 00, HVAC and Plumbing Insulation.

1.3 QUALITY ASSURANCE

A. **Reference Standards.** Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. ANSI A13.1, Scheme for the Identification of Piping Systems.
2. ANSI A21.10-93, Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids (AWWA C110).
3. ANSI A21.11-95, Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings (AWWA C111).
4. ANSI A21.51-96, Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids (AWWA C151).

5. ANSI B16.3-92, Malleable-Iron Threaded Fittings.
6. ANSI B16.5-96, Pipe Flanges and Flanged Fittings NPS ½ through NPS 24.
7. ANSI B16.15-85, Cast Bronze Threaded Fittings, classes 125 and 250.
8. ANSI B16.22-95, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
9. ANSI B16.24-91, Cast Copper Alloy Pipe Flanges and Flanged Fittings.
10. ANSI B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.
11. ANSI B125.2, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Pipe for Ordinary Uses (ASTM A 120).
12. ANSI H23.1, Seamless Copper Water Tube (ASTM B 88).
13. ANSI H27.1, Seamless Red Brass Pipe, Standard Sizes (ASTM B 43).
14. ASTM A 183, Carbon Steel Track Bolts and Nuts.
15. ASTM A 307, Carbon Steel Externally and Internally Threaded Standard Fasteners.
16. ASTM B 32, Solder Metal.
17. ASTM D 1330-85, Rubber Sheet Gaskets.
18. ASTM D 2000-96, Rubber Products in Automotive Applications.
19. FS 0-F-506B, Flux Soldering: Paste and Liquid.
20. FS WW-U-531C, Unions, Pipe; Steel or Malleable Iron; Threaded Connection.
21. FS WW-U-516, Unions, Brass or Bronze; 250 pound.
22. PDI WH-201.
23. ANSI/AWWA C651-92, Disinfecting Water Mains.

B. The specifications in this Section are subject to the administrative and procedural requirements specified in Division 1, as well as the broader requirements of the General Conditions.

1.4 **PERFORMANCE REQUIREMENTS**

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig.
2. Sanitary waste and vent piping: 10-foot head of water.
3. Storm drainage piping: 10-foot head of water.

1.5 **SUBMITTALS**

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Product Data: For the following:
    a. Pipe and Fittings.
    b. Valves.
    c. Backflow Preventers and Vacuum Breakers.
    d. Strainers.
    e. Water Hammer Arresters.
    f. Hose Bibbs and Wall Hydrants.
    g. Dielectric Couplings.
    h. Water – Tempering Equipment.
    i. Trap seal primer valves.
    j. Floor drains
    k. Floor drain inlet fittings
    l. Roof drains

B. Submit detailed ¼-inch scale drawings showing materials and dimensions of the complete potable water piping system, in plan and in section.

C. **Product Data**. Submit data for new or replacement equipment and parts.

D. **Quality Assurance/Control Submittals**

1. Submit certificate on pressure testing.

E. **Operation and Maintenance Manuals**

1. Submit to the ENGINEER complete Operation and Maintenance Data in accordance with Division 1.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

1. All material labels or tags will be intact and legible.

1.7 WARRANTY

A. The manufacturer shall provide a written warranty on equipment, materials, parts and labor in the name of the Owner. The warranty period shall begin on the date of final acceptance of all the pumping equipment by the Owner. The warranty period shall be for a two-year duration. Warranty must be fully executed and signed by the CONTRACTOR and the manufacturer prior to final completion.

1.8 DEFINITIONS

A. **W.O.G.** Non-shock cold water, oil or gas.

B. **N.P.T.** National Pipe Threads.

C. **P.S.I.** Pounds per square inch (pressure).

D. **I.P.S.** Iron Pipe Size.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **Water Hammer Arresters**

1. Product and Manufacturer: Provide water hammer arresters manufactured by one of the following:
    a. Hydrotrol by Jay R. Smith Manufacturing Company
    b. Shoktrol by Zurn Industries.
    c. Watts Regulator Co.
    d. Or approved equal
2. Materials:
    a. Casing: Stainless Steel
    b. Bellows: Stainless Steel
    c. Bellows contents: Nitrogen gas
3. Connections: Male NPT thread.
4. Maximum Working Pressure: 250 psig
5. Sizing and Certification: P.D.I. WH-201

B. **Automatic Air Vents**

1. Product and Manufacturer: Provide air vents manufactured by one of the following:
    a. Conbraco
    b. Armstrong Pumps, Inc.
    c. Honeywell Water Controls
    d. Or approved equal
2. Type: Automatic vent air eliminator with built-in air chamber
3. Construction:
    a. Body: Bronze
    b. Finish: Chrome plated exterior
    c. Overflow connector: Provide connection for ¼ inch OD copper tubing
    d. Ratings: 75 psig working pressure

C. **Balancing valves**

1. Product and Manufacturer: Provide air vents manufactured by one of the following:
    a. Amtrol, Inc.

b. Armstrong Pumps, Inc.

c. Flow Design, Inc.

d. ITT Industries; Bell & Gossett Div.

e. Taco, Inc.

f. Or approved equal

2. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.

3. NPS 2 and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.

4. NPS 2 and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.

D. **Drains**

1. Roof Drains - RD:

a. Manufacturer:
1) J. R. Smith Manufacturing Co., Fig.1015Y-R-C
2) Or approved equal.

b. Type & Size: Round top, diameter as indicated on plans.

c. Material:
1) Body: Duco cast iron with adjustable extension sleeve, reversible collar, combined flashing clamp and gravel stop, no-hub outlet.
2) Dome: Cast iron.

2. Floor Drain - FD:

a. Type & Size: 8” Round top, 4” outlet size.

b. Material:
1) Body: Duco cast iron, with flashing collar and adjustable strainer, no-hub outlet, with trap primer connection.
2) Grate: nickel bronze, type A.

c. Manufacturer:
1) J. R. Smith Manufacturing Co., Fig.2005Y-(A).
2) Or approved equal.

3. Floor Drain Inlet Fittings:

a. Product and Manufacturer:
1) J.R. Smith Manufacturing Co., Fig. 2695Y
2) Watts Drainage Products
3) Zurn Plumbing Products Group
4) Or approved equal

b. Floor drain inlet fitting shall be cast iron, with threaded inlet and no-hub outlet and trap seal primer valve connection.

E. **Cleanouts**

1. Floor Cleanouts:
    a. Type: Round top, heavy-duty, adjustable.
    b. Size: The same size as the pipe they serve up to 4", 4-inch for larger pipes.
    c. Material:
        1) Duco cast iron body.
        2) PVC Plug.
    d. Manufacturer:
        1) J. R. Smith Manufacturing Co., Fig.4105C.
        2) Or equal.
2. Tee (at the riser), In-line and Pipe Cleanouts-CO:
    a. Size: The same size as the pipe they serve up to 4", 4-inch for larger pipes.
    b. Type: Taper thread plug with round frame and cover.
    c. Material:
        1) Duco cast iron spigot ferrule, cast bronze plug.
    d. Manufacturer:
        1) J. R. Smith Manufacturing Co., Fig.4436C
        2) Or equal.
3. Wall Cleanout:
    a. Size: 4-inch for 4-inch and larger pipes.
    b. Type: Taper thread plug with round frame and cover.
    c. Material:
        1) Duco cast iron spigot ferrule, cast bronze plug.
    d. Manufacturer:
        1) J. R. Smith Manufacturing Co, Fig. 4436C
        2) Or equal.

F. **Strainers**

1. Type: "Y" Body self-cleaning with blow-off cock.
2. Materials:
    a. Body: Bronze or cast iron.
    b. Screen: 20 mesh Monel, for sizes through 2-inch, 1/16-inch brass for sizes 2½-inch through 3-inch.
3. Connections: Threaded.
4. Manufacturer:
    a. Mueller Steam Specialty Company
    b. Armstrong steam Specialty Company.

c. Or equal.

G. **Hose Bibb HB**

1. Valve:

a. Type: Globe, Hose end, 300 pounds per square inch non-shock cold water; renewable composition disc; screw in bonnet; female threaded inlet.

b. Materials: Bronze construction.

c. Inlet Size: ¾-inch.

d. Hose Thread Size: ¾-inch, match plant standard thread.

e. Accessories: Provide the following with each hose bib.
1) Cap and chain.
2) Vacuum breaker.

f. Operation: Handwheel.

2. Vacuum Breaker:

a. Type: Non-removable, atmospheric.

b. Materials: Brass body, silicon rubber diaphragm and stainless steel disc.

3. Manufacturer:

a. NIBCO.

b. Or equal.

H. **Freeze-proof Wall Hydrant**

1. Type: Anti-siphon, non-freeze.

2. Material:

a. Casing: Bronze nickel plated.

3. Connection:

a. Inlet: 1-inch sweat end.

b. Outlet: 1-inch hose thread, universal type.

4. Vacuum Breaker: Integral.

5. Wall Clamp: Adjustable with setscrew.

6. Manufacturer:

a. Jay R. Smith Manufacturing Company, Fig. No. 5609QT-WH.

b. Zurn Plumbing Products Group.

c. NIBCO.

d. Or approved equal.

I. **Backflow Preventer.** ¾-inch to 2 inches

1. Type: Reduced pressure principle.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range
5. Materials:
    a. Body and Cover: Cast iron, ASTM 126.
    b. Main Valve Trim: Bronze, ASTM B-61.
    c. Differential Relief Valve: Bronze STM B-61 with stainless steel 316 trim.
6. Maximum Working Pressure: 175 pounds per square inch gage.
7. Fluid: Water.
8. Temperature Range: 35 degrees F to 110 degrees F.
9. End Connections: Threaded for NPS 2 and smaller.
10. Configuration: Designed for horizontal, straight through flow.
11. Accessories:
    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    c. Accessories: Strainer.
12. Manufacturer:
    a. Watts Regulator, 009 Series.
    b. Or equal.

J. **Vacuum Breaker.** Pressure Type.

1. Type: To prevent back siphoning of contaminated water into a potable water supply.
2. Materials:
    a. Hood: Stainless steel.
    b. Bonnet: Bronze.
    c. Vent Disc: Silicone rubber.
    d. Disc Holder Float: Polyethylene.
    e. Check Valve Disc: Silicone rubber.
    f. Check Valve Seat: Bronze.
    g. Body: Bronze.
3. Accessories:

a. Gate valves on inlet and outlet.

b. Ball valve test cocks.

4. Reference: ASSE Standard No. 1020.

5. Working Pressure: 150 pounds per square inch.

6. Installation: Vertical, minimum 12 inches above fixture vacuum breaker serves.

7. Manufacturer:

a. Watts Regulator Company No. 800.

b. Or equal.

K. **Trap Seal Primer Valves**

1. Product and Manufacturer: Provide trap primer valves by one of the following:

a. Precision Plumbing Products, Inc., Model PR-500.

b. Watts Regulator Co.

c. Zurn Plumbing Products Group

d. Or approved equal

2. Construction:

a. Body: Brass

b. Seals: O-ring 40 degrees F to 450 degrees F

c. Inlet and Outlet: 1/2 inch

d. Integral backflow preventer, vacuum breaker: ASSE 1001.

e. Standard: ASSE 1044,

f. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power (where are indicated on plans).

3. Provide Distribution Units as required

a. Body: Brass.

b. Seals: O-ring 40 degrees F to 450 degrees F.

c. Inlet and Outlet: 1/2-inch.

L. **Water Tempering Equipment TMV-A**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc., model Rada Z358-40

b. Lawler Manufacturing Company, Inc.

c. Leonard Valve Company.

d. Powers; a Watts Industries Co.

e. Symmons Industries, Inc.

f. Or approved equal.

2. Standard: ASSE 1017.

3. Pressure Rating: 150 psig.

4. Type: Exposed-mounting, thermostatically controlled water mixing valve.

5. Material: Chrome-plated DZR brass/stainless steel construction.

6. Connections: Threaded inlets and outlet.

7. Accessories: Manual temperature control, integral inlet check valves and strainers, adjustable temperature-control handle, integral thermometer, integral sight flow indicator, integral thermostatic return limiter.

8. Tempered-Water Setting: 85 deg F .

9. Tempered-Water Design Flow Rate: 23 gpm .

10. Supplied by packaged tepid water heating system manufacturer. Refer to Division 22 Section 22 33 00 “Electric Domestic Water Heaters”.

2.2 **FINISHES**

A. All non-insulated water piping shall be primed and finished painted in accordance with Division 9 Section “Painting”.

PART 3 - EXECUTION

3.1 **INSPECTION**

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 **PREPARATION**

A. No Work is to begin without submittal review and ENGINEER notification.

3.3 **INSTALLATION**

A. Coordination. Review installation procedures under other sections and coordinate the Work that must be installed with or attached to the plumbing system.

B. Performance. All Work shall be done by a firm experienced and properly manned and tooled in the Work specified.

C. Pipe sizes specified are for nominal inside dimensions.

D. All work will be properly supported to prevent any movement when in service.

E. The finished installed Work is to be properly identified and labeled by approved means.

F. Insulate all hot and cold copper water piping as described in Section 23 07 00, HVAC and Plumbing Insulation.

G. Installation of potable water piping shall be in accordance with Section 22 05 00, Common Work Results for Plumbing.

H. All piping shall be pitched to facilitate draining. Drain valves shall be furnished at system low points.

I. Provide harnessed flexible couplings on all equipment suction and discharge lines.

J. Harnessed flexible couplings or pipe loops shall be provided on all piping subject to thermal expansion.

K. Isolation valves and unions shall be provided for all piping at connections to equipment and when a branch line joins a main line.

L. All connections between ferrous and non-ferrous piping materials shall be made with dielectric couplings.

M. Care shall be taken so as not to leave tool marks or abrasions on plated, polished, or soft metal piping.

N. Wherever changes in sizes of piping occur, changes shall be made with reducing fittings. The use of bushings is not permitted unless otherwise shown.

O. All exposed unfurred (not in walls) pipes, whether insulated or not, shall be identified with pipe labels and the direction of flow indicated. Labels may be omitted from piping where the use is obvious, due to its connections to fixtures and where the appearance would be objectionable in finished rooms; as approved by the OWNER or OWNER's Representative.

1. Near each valve and branch connection.
2. Wherever piping emerges or disappears from view, when viewed from the floor of the room in which it is installed.
3. At not more than 50 foot intervals.

P. All pipes entering ceilings, floors, and walls in finished areas, and all piping to fixtures shall have escutcheon plates.

Q. Seal or cap all piping at the end of each workday.

R. All exposed water piping to plumbing fixtures shall be chrome-plated brass, unless otherwise specified.

S. Soft annealed copper tubing may be used for temporary work.

T. All valves for copper or brass piping shall be bronze bodied unless otherwise specified.

U. Water hammer arresters shall be sized in accordance with PDI-WH201.

V. Provide backflow preventers wherever local code requires and at all building potable water system connection(s) to the plant Water Distribution System and at all connection(s) of the building potable water system to process water systems, process equipment, or chemically-treated potable water user systems or equipment.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor

drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Do not install bypass piping around backflow preventers.

W. Provide vacuum breakers wherever local code requires and wherever potable water is supplied without direct connection to process areas or equipment.

X. Use frost-proof wall hydrants or hose bibbs for outside use.

Y. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers in supply and outlet piping connections to water-tempering equipment.

2. Install cabinet-type units recessed in or surface mounted on wall as specified.

Z. Install air vents at high points of water piping.

3.4 FIELD QUALITY CONTROL

A. **Pressure testing.** Comply with Section 22 13 16, “Plumbing Piping”.

B. Repair or replace any damaged components as directed by the ENGINEER.

C. Water-tempering equipment will be considered defective if it does not pass tests and inspections.

3.5 CLEANING AND DISINFECTION

A. Comply with Division 1 sections.

B. Comply with the disinfection requirements in Section 22 13 16, “Plumbing Piping”.

C. The CONTRACTOR shall submit certification that all potable water piping has been disinfected.

END OF SECTION

SECTION 22 14 29

SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install the plumbing fixtures as shown and specified.

B. Coordination

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with plumbing fixtures.

C. Related Sections

1. Division 01, General Requirements.
2. Section 22 05 00, Common Work Results for Plumbing.
3. Section 22 13 16, Plumbing Piping.
4. Section 22 13 19, Plumbing Specialties.
5. Section 23 05 29, HVAC and Plumbing Piping and Equipment Hangers and Supports.
6. Section 23 07 00, HVAC and Plumbing Insulation.

1.3 QUALITY ASSURANCE

A. **Reference Standards.** Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. Standards of the Hydraulic Institute.
2. National Electric Code.
3. Standards of National Electrical Manufacturers Association.
4. Institute of Electrical and Electronic Engineers.
5. American National Standards Institute.
6. Standards of American Water Works Association.

B. **Requirements of Regulatory Agencies**

1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:

   a. Ohio Basic Building Code.
   b. Ohio Plumbing Code.

C. **Electrical Components, Devices, and Accessories.** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. **UL Compliance.** Comply with UL 778 for motor-operated water pumps.

1.4 **SUBMITTALS**

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Product Data. For the following:

   a. Sump pump.
   b. Assembly of parts lists.
   c. Any other fixtures utilized on this project not listed above.

B. **Operation and Maintenance Manuals**

1. Submit to the ENGINEER complete Operation and Maintenance Data in accordance with Division 1.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

B. All material labels or tags will be intact and legible.

C. Retain shipping flange protective covers and protective coatings during storage.

D. Protect bearings and couplings against damage.

E. Comply with pump manufacturer's written rigging instructions for handling.

1.6 **WARRANTY**

A. The manufacturer shall provide a written warranty on equipment, materials, parts and labor in the name of the Owner. The warranty period shall begin on the date of final acceptance of all the pumping equipment by the Owner. The warranty pe-

riod shall be for a two-year duration. Warranty must be fully executed and signed by the CONTRACTOR and the manufacturer prior to final completion.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. **Available Manufacturers**

1. Zoeller
2. Weil Pump Co.
3. Bell & Gossett
4. Or approved equal

B. **Description.** Factory-assembled and -tested, simplex, single-stage, centrifugal, submersible, plug-in sump pumps complying with UL 778 and HI 1.1-1.2 and HI 1.3 for submersible sump pumps.

1. Casing and Impeller: Cast-iron or plastic casing with inlet strainer and metal or plastic impeller.
2. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
3. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump.
4. Moisture-Sensing Probe: Internal moisture sensor with moisture alarm.

C. **Pump Discharge Piping.** Factory or field fabricated, ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe.

D. **Controls**

1. Switch Type: Mechanical-float or Mercury-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
2. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float or mercury-float switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

E. **Piping, Valves and Fittings**

1. Threaded Union
2. Shutoff Valve
3. Check Valve
4. Size as noted on plans
5. Connect to existing discharge piping
6. Material shall be schedule 40 pvc unless otherwise noted on the plans.

F. **Capacity and Characteristics.** See drawings.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. **Pump Installation Standards.** Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Plumbing Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

A. **Tests and Inspections**

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. See Division 1 for retesting and reinspecting requirements and for requirements for correcting the Work.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain pumps.

END OF SECTION

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SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope**
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install the plumbing fixtures as shown and specified.

B. **Coordination**
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with plumbing fixtures.

C. **Related Sections**
   1. Division 1, General Requirements.
   2. Section 22 05 00, Common Work Results for Plumbing.
   3. Section 22 13 16, Plumbing Piping.
   4. Section 22 13 19, Plumbing Specialties.
   5. Section 23 05 29, HVAC and Plumbing Piping and Equipment Hangers and Supports.
   6. Section 23 07 00, HVAC and Plumbing Insulation.

1.3 QUALITY ASSURANCE

A. **Requirements of Regulatory Agencies**
   1. Building Codes. Comply with applicable requirements of all governing authorities and the following codes:
      a. Ohio Basic Building Code.
      b. Ohio Plumbing Code.

B. **Electrical Components, Devices, and Accessories.** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. **ASHRAE/IESNA 90.1 Compliance.** Applicable requirements in ASHRAE/IESNA 90.1.

D. **ASME Compliance.** Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. **NSF Compliance.** Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:
   1. Product Data. For the following:
      a. For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. **Product Certificates.** For each type of commercial electric, domestic-water heater, from manufacturer.

C. **Operation and Maintenance Manuals**
   1. Submit to the ENGINEER complete Operation and Maintenance Data in accordance with Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.
   1. All material labels or tags will be intact and legible.

1.6 WARRANTY

A. **Special Warranty.** Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Periods. From date of Substantial Completion.
      a. Commercial, Electric, Storage, Domestic-Water Heaters:
         1) Storage Tank: Five years.
         2) Controls and Other Components: Five years.
      b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 PACKAGED TEPID WATER HEATING SYSTEM

A. **Available Manufacturers**
   1. Hubbell Model EMV-120.
   2. Or approved equal.

B. Comply with UL 1453 requirements for storage-tank-type water heaters.

C. **Storage-Tank Construction.** Steel vertical arrangement.
   1. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
   2. Pressure Rating: 150 psig.
   3. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

D. **Factory-Installed Appurtenances and Accessories**
   1. Anode Rod: Replaceable magnesium.
   2. Drain Valve: Factory installed, corrosion-resistant metal complying with ASSE 1005.
   3. Insulation: Comply with ASHRAE/IESNA 90.1.
   4. Jacket: Steel with enameled finish.
   5. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
   6. Temperature Control: Adjustable thermostat.
   7. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
   8. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
   9. Thermostatic mixing valve –factory packaged and piped, set to 85 deg.

E. **Accessories**
   1. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.
   2. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004 or ASHRAE 90.2-2004.
   3. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

F. **Capacity and Characteristics.** See drawings.

2.2 COMPRESSION TANKS

A. **Available Manufacturers**
   1. ELBI of America.
   2. AMTROL Inc.
   3. Taco, Inc.
   4. Or approved equal.

B. **Description.** Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.

C. **Construction**
   1. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
   2. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   3. Air-Charging Valve: Factory installed.

D. **Capacity and Characteristics**
   1. Working-Pressure Rating: 150 psig.
   2. Air Pre-charge Pressure: 40 psig.
   3. Capacity: See drawings.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 DOMESTIC-WATER HEATER INSTALLATION

A. **Commercial, Electric, Domestic-Water Heater Mounting.** Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
   1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   7. Install anchor bolts to elevations required for proper attachment to supported equipment.
   8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater re-

lief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains.

E. Install thermometers on outlet piping of electric, domestic-water heaters.

F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

G. Fill electric, domestic-water heaters with water.

H. Charge domestic-water compression tanks with air.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Plumbing Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.4 IDENTIFICATION

A. **Identify system components.** Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 SOURCE QUALITY CONTROL

A. **Factory Tests.** Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 1 for retesting and re-inspecting requirements and for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 1 for retesting and re-inspecting requirements and for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.7 **DEMONSTRATION**

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope**
1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install the plumbing fixtures as shown and specified.

B. **Coordination**
1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with plumbing fixtures.

C. **Related Sections**
1. Division 1, General Requirements.
2. Section 22 05 00, Common Work Results for Plumbing.
3. Section 22 13 16, Plumbing Piping.
4. Section 22 13 19, Plumbing Specialties.
5. Section 23 05 29, HVAC and Plumbing Piping and Equipment Hangers and Supports.
6. Section 23 07 00, HVAC and Plumbing Insulation.

1.3 QUALITY ASSURANCE

A. **Reference Standards.** Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. FS WW-P-54 lb., Plumbing Fixtures-Land Use.

B. **Requirements of Regulatory Agencies**
1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
   a. Ohio Basic Building Code.
   b. Ohio Plumbing Code.

C. **NSF Standard.** Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:
1. Product Data: For the following:
   a. Water closets.

b. Lavatories
c. Urinals
d. Assembly of parts lists.
e. Any other fixtures utilized on this project not listed above.

B. **Operation and Maintenance Manuals**
1. Submit to the ENGINEER complete Operation and Maintenance Data in accordance with Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.
1. All material labels or tags will be intact and legible.

1.6 WARRANTY

A. The manufacturer shall provide a written warranty on equipment, materials, parts and labor in the name of the Owner. The warranty period shall begin on the date of final acceptance of all the pumping equipment by the Owner. The warranty period shall be for a two-year duration. Warranty must be fully executed and signed by the CONTRACTOR and the manufacturer prior to final completion.

1.7 DEFINITIONS

A. **Plumbing Fixture.** Fixture with fixed, potable-water supply.

PART 2 - PRODUCTS

2.1 LAVATORY (LAV)

A. **Wall hung lavatory**
1. Manufacturer:
1) American Standard
2) Zurn
3) Sloan.
4) Or approved equal.

2. Materials:
a. Basin: Vitreous china wall mounted, 21" x 18", single center faucet, Model SS-3003 by Sloan. Floor mounted support in chase areas, wall mounted support in non-chase areas.

b. Trim: Chicago Faucet No. 802-317ABCP supply faucet, wrist blade handles, chrome plated offset wheelchair grid drain, chrome plated 1-1/4 inch 17 gauge brass P-trap and arm with escutcheon; 3/8 inch loose key angle stops with flexible supplies. Install Trap Wrap (or approved equal) to supply and drain lines. Install ASSE 1070 mixing valve.

2.2 URINAL (UR)

A. **Wall hung urinal**
   1. Manufacturer:
      1) American Standard
      2) Zurn
      3) Sloan.
      4) Or approved equal.

   2. Materials:
      a. Urinal: Vitreous china, washout flush, integral trap, 3/4 inch top spud, with carrier, Sloan Model SU-1009 with optima smooth #186-0.125 DBP smooth flush valve, 0.125 gpm. Battery operated flush valve

      b. Flush Valve: Exposed battery operated flushometer; Sloan No. #186-0.125 DBP smooth flush valve.

2.3 WATER CLOSET (WC)

A. **Floor mounted water closet**
   1. Manufacturer:
      1) American Standard
      2) Zurn
      3) Sloan.
      4) Or approved equal.

   2. Materials:
      a. Bowl: Wall mounted, vitreous china, water closet & flushometer combo, elongated rim; Sloan No. WETS-2450.1420. Battery operated flush valve. Mount at ADA height

      b. Seat: Solid white plastic, open front, extra heavy, stainless steel hinge; Bemis Model No. 1955CT.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install

valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Division 22 Section "Plumbing Piping."

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals.

F. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system.

G. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

3.3 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Connect hot- and cold-water-supply piping to hot- and cold-water fixtures. Comply with requirements for hot- and cold-water piping specified in Division 22 Section "Plumbing Piping."

C. Where installing piping adjacent to plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on plumbing fixtures. Comply with requirements for identification materials specified in Section 23 05 53 "HVAC and Plumbing Identification."

3.5 FIELD QUALITY CONTROL

A. Upon completion of the Work, all labels shall be removed, fixtures and trim shall be cleaned of all dirt, grease and markings, all valves properly adjusted, and all units shall be in working order.

B. **Mechanical-Component Testing.** After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

C. **Tests and Inspections**

2. Perform each visual and mechanical inspection.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After plumbing connections have been made, run units to confirm proper unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. See Division 1 for retesting and reinspecting requirements for correcting the Work.

E. Plumbing fixtures will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 **ADJUSTING**

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

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SECTION 22 45 00

EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope**
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install the plumbing fixtures as shown and specified.

B. **Coordination**
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with plumbing fixtures.

C. **Related Sections**
   1. Division 1, General Requirements.
   2. Section 22 05 00, Common Work Results for Plumbing.
   3. Section 22 13 16, Plumbing Piping.
   4. Section 22 13 19, Plumbing Specialties.
   5. Section 23 05 29, HVAC and Plumbing Piping and Equipment Hangers and Supports.
   6. Section 23 07 00, HVAC and Plumbing Insulation.

1.3 QUALITY ASSURANCE

A. **Reference Standards.** Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. FS WW-P-54 lb., Plumbing Fixtures-Land Use.

B. **Requirements of Regulatory Agencies**
   1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
      a. Ohio Basic Building Code.
      b. Ohio Plumbing Code.

C. **Electrical Components, Devices, and Accessories.** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. **ANSI Standard.** Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

E. **NSF Standard.** Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:
   1. Product Data: For the following:
      a. Safety showers.
      b. Assembly of parts lists.
      c. Any other fixtures utilized on this project not listed above.

B. **Operation and Maintenance Manuals**
   1. Submit to the ENGINEER complete Operation and Maintenance Data in accordance with Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.
   1. All material labels or tags will be intact and legible.

1.6 WARRANTY

A. The manufacturer shall provide a written warranty on equipment, materials, parts and labor in the name of the Owner. The warranty period shall begin on the date of final acceptance of all the pumping equipment by the Owner. The warranty period shall be for a two-year duration. Warranty must be fully executed and signed by the CONTRACTOR and the manufacturer prior to final completion.

1.7 DEFINITIONS

A. **Plumbed Emergency Plumbing Fixture.** Fixture with fixed, potable-water supply.

B. **Tepid.** Moderately warm.

PART 2 - PRODUCTS

2.1 EMERGENCY SHOWERS – COMBINATION UNITS

A. **Corrosion Resistant Emergency Eyewash and Drench Shower Station**
   1. Manufacturer:
      a. Inside combination drench shower/eyewash unit: ESHR:
         1) Haws Co., Model 8336.
         2) Speakman.
         3) Or approved equal.
   2. Materials:
      a. Shower Head: 10-inch diameter ABS Plastic. Valve: 1-inch IPS 316 stainless steel ball valve with flow regulator and stay-open control valve, operated by stainless steel pull chain with ring handle.
      b. Eyewash: 11-inch diameter ABS Plastic bowl with Axion MSR eye/face wash heads and ABS Plastic dust cover assembly
      c. Schedule 80 PVC vertical piping with 2 ½”-inch diameter PVC floor flange.

d. Unit Supply and Waste: 1¼-inch IPS.
e. Identification Sign: 14-inch by 3½-inch plastic sign designed for wall mounting
f. Inside units shall be combination drench shower/eyewash unit.
g. Outside units shall be cable heated combination eyewash/drench shower units. With stay-open ball valves located inside building.
h. CONTRACTOR to supply all pipe fittings, and appropriate support brackets and hangers to install eyewashes and drench showers.
i. Pipe and fittings shall be Schedule 80 PVC.
j. All hardware to be stainless steel.

3. Alarm System:
   a. Type: Audible and visual alarm system, complete and factory wired, except for power connection, operated by a waterproof flow switch.
   b. Light: Strobe type, 258,000 candlepower, solid state, weatherproof.
   c. Alarm: 103 decibels at 10 feet.
   d. Flow Switch: Paddle-type, for horizontal mounting. AC, 125 volt, 5 amps, single pole, double throw UL listed, NEMA 4X stainless steel enclosure.
      1) Provide relays and enclosures as necessary to provide inputs necessary for local alarm local annunciators and any other indication required by the application or shown on the Drawings.
      2) Bradley Corp., Model S19-320, or equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Division 22 Section "Plumbing Piping."
   1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
   2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals.

F. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system.

G. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

3.3 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Division 22 Section "Plumbing Piping."

C. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 23 05 53 "HVAC and Plumbing Identification."

3.5 FIELD QUALITY CONTROL

A. Upon completion of the Work, all labels shall be removed, fixtures and trim shall be cleaned of all dirt, grease and markings, all valves properly adjusted, and all units shall be in working order.

B. **Mechanical-Component Testing.** After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

C. **Tests and Inspections**

2. Perform each visual and mechanical inspection.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. See Division 1 for retesting and reinspecting requirements for correcting the Work.

E. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 **ADJUSTING**

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

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SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **General**: Provide all labor, materials, tools, and equipment necessary to furnish and install HVAC equipment and systems in accordance with the drawings and as specified herein.

B. **This Section includes the following**:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Grout
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.
12. Sealing HVAC related openings/work between at surfaces of wet areas.
13. Condensate drains.

1.3 QUALITY ASSURANCE

A. **Steel Support Welding**: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. **Electrical Characteristics for HVAC Equipment**: Equipment of higher greater electrical demands (such as hp, current, etc.) may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Product Data for the following:

a. Sleeves.

b. Supports and anchorages.
c. Mechanical sleeve seals.

2. Welding certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Deliver duct sections and HVAC equipment with openings covered and protected.

D. Store plastic pipes and FRP ductwork and FRP accessories protected from direct sunlight. Support to prevent sagging and bending.

1.6 DEFINITIONS AND ABBREVIATIONS

A. **Finished Spaces**: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. **Exposed, Interior Installations**: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. **Exposed, Exterior Installations**: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. **Concealed, Interior Installations**: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. **Concealed, Exterior Installations**: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.

3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.7 COORDINATION

A. Arrange for pipe and duct spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Architectural surface access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. **Flange Bolts and Nuts**: ASME B18.2.1, stainless steel, unless otherwise indicated.

D. **Plastic, Pipe-Flange Gasket, Bolts, and Nuts**: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. **Solder Filler Metals**: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. **Brazing Filler Metals**: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. **Welding Filler Metals**: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. **Solvent Cements for Joining Plastic Piping**:

1. CPVC Piping: ASTM F 493.

2.3 MECHANICAL SLEEVE SEALS

A. **Description**: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Or equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

A. **Galvanized-Steel Sheet**: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, for non-corrosive areas.

B. **Steel Pipe**: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends, for non-corrosive areas.

C. **Sheet and Pipe for Corrosive Areas**: Similar to two items directly above but stainless steel.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.6 CONDENSATE DRAINS

A. Drains to be CPVC.

2.7 EQUIPMENT/COMPONENT FEATURES FOR ALARMING TO/THRU SCADA SYSTEM

A. Provide and install project equipment/components with necessary switches, outputs, inputs, etc. to allow proper alarming by same to building SCADA systems, refer to Section 23 09 93.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

E. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

3.5 PAINTING

A. Any required painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment and/or curbs to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 SEALING HVAC RELATED OPENINGS/WORK AT SURFACES OF WET AREAS

A. Seal all Division 23 penetrations and work (including sealing inside and around any control conduits) at all surfaces common to wet areas (such as filter rooms). Refer to architectural specifications for sealer type.

END OF SECTION

SECTION 23 05 13

HVAC MOTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install motors.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with motors.

1.3 QUALITY ASSURANCE

A. Reference Standards: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. NFPA 70, National Electric Code.
   2. National Electrical Manufacturers Association (NEMA).

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

   1. Shop Drawings: Submit for approval the following:

      a. Dimensional Data.

      b. Power and Control Wiring Diagram.

      c. Clear statement of suitability of motor for corrosive airstream/environment and/or for classified/explosion-proof space or airstream use as required on project.

   2. Operation and Maintenance Data.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

1.6 **COORDINATION**

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
   1. Compatible with the following:
      a. Magnetic controllers.
      b. Multispeed controllers.
      c. Reduced-voltage controllers.
      d. Variable frequency drives.
   2. Matched to torque and horsepower requirements of the load.
   3. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

C. Coordinate size and location of concrete bases or motor driven equipment. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section.

1.7 **WARRANTY**

A. The manufacturer shall provide a written warranty on equipment, materials, parts and labor in the name of the Owner. The warranty period shall begin on the date of final acceptance of all the pumping equipment by the Owner. The warranty period shall be for a two year duration. Warranty must be fully executed and signed by the CONTRACTOR and the manufacturer prior to final completion.

PART 2 - PRODUCTS

2.1 **MOTOR CHARACTERISTICS (UNLESS SCHEDULED DIFFERENTLY)**

A. Motors 1/2 HP and Larger: Three phase.

B. Motors equal to or smaller than 1/3 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for totally enclosed motors.

F. Normal Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 330 ft above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Totally enclosed fan cooled (TEFC), unless otherwise indicated or otherwise required for installation location.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficiency, as defined in NEMA MG 1.

C. Stator: Copper windings, unless otherwise indicated.
   1. Multispeed motors shall have separate winding for each speed or shall be two-speed/one winding per the drawing schedules.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or G.
   2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristics.

I. Enclosure: Cast iron for motors 7.5 HP and larger; rolled steel for motors smaller than 7.5 HP.
   1. Finish: Manufacturer's standard.

2.3 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Designed with critical vibration frequencies outside operating range of controller output.
   2. Temperature Rise: Matched to rating for Class B insulation.
   3. Insulation: Class H
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
   5. VFD rated.

C. Rugged-Duty Motors (required in corrosive areas/airstreams): Totally enclosed fan cooled, with 1.25 minimum service factor and greased bearings. Windings insulated with non-hygroscopic material, and applied in a double dip and bake process. Motor Housing Finish: Corrosion-resistant primer and with mill and chemical duty paint to withstand minimum 500 hours ASTM B117-90 Salt Spray Test.

D. Explosion-Proof Motors: Provide as scheduled.

E. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
   1. Measure winding resistance
   2. Read no-load current and speed at rated voltage and frequency.
   3. Measure locked rotor current at rated frequency.
   4. Perform high-potential test.

2.4 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split-phase start, capacitor run.
   3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated—sleeve type for other single-phase motors.

E. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
   1. Measure winding resistance.
   2. Read no-load current and speed at rated voltage and frequency.
   3. Measure locked rotor current at rated frequency.
   4. Perform high-potential test.

2.5 SINGLE PHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Rugged-Duty Motors (required in moist and/or corrosive areas/airstreams): Totally enclosed fan cooled, with 1.25 minimum service factor and greased bearings. Windings insulated with non-hygroscopic material, and applied in a double dip and bake process. Motor Housing Finish: Corrosion-resistant primer and with mill and chemical duty paint to withstand minimum 500 hours ASTM B117-90 Salt Spray Test.

B. Explosion-Proof Motors: Provide as scheduled.

C. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
   1. Measure winding resistance
   2. Read no-load current and speed at rated voltage and frequency.
   3. Measure locked rotor current at rated frequency.
   4. Perform high-potential test.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

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SECTION 23 05 16

HYDRONIC PIPING SPECIALTIES

PART 1-GENERAL

1.1 SECTION INCLUDES

A. ASME safety relief valves.

B. Manual and automatic air vents.

C. ASME compression and expansion tanks.

D. Air separators with automatic air vents.

E. Strainers.

1.2 SUBMITTALS

A. Submit shop drawings and product data per applicable Division I Specification.

B. Shop drawings shall include product data noting materials, sizes, and dimensions.

1.3 QUALITY ASSURANCE

A. Pressure piping shall meet ASME B31.9 Code.

B. Safety relief valve requirements shall meet ASME Boiler and Pressure Vessel Code.

C. To assure uniformity and compatibility of piping components in grooved piping systems. All grooved products utilized shall be supplied by one manufacturer.

PART 2-PRODUCTS

2.1 Diaphragm-Operated Safety Valves: ASME labeled.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the **following:**
   a. Bell & Gossett Domestic Pump.
   b. Conbraco Industries, Inc.
   c. Spence Engineering Company, Inc.
   d. Watts Regulator Co.
   e. Kunkle.

2. **Body:** Bronze or brass.
3. **Disc:** Glass and carbon-filled PTFE.
4. **Seat:** Brass.
5. **Stem Seals:** EPDM O-rings.
6. **Diaphragm:** EPT.
7. **Wetted, Internal Work Parts:** Brass and rubber.
8. Inlet Strainer: Stainless steel, removable without system shutdown.

9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.3 MANUAL AIR VENTS

A. Provide 1/2 inch diameter piping loop with ball valve and standard hose end connection.

2.4 AUTOMATIC AIR VENTS

A. High capacity with float operation. Constructed of cast iron body with stainless steel, brass and EPDM internal parts. Rated for 250 degrees F at 150 psig. Unit shall be designed not to allow air into the vent in case of system pressure dropping below atmospheric pressure. Use for relieving air from the system at the air separator only.

1) **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a) Bell & Gossett Domestic Pump.
   b) Nexus Valve, Inc.
   c) Taco, Inc.
   d) Armstrong.
2) **Body:** Bronze or cast iron.
3) **Internal Parts:** Nonferrous.
4) **Operator:** Noncorrosive metal float.
5) **Inlet Connection:** NPS 1/2.
6) **Discharge Connection:** NPS 1/4.
7) **CWP Rating:** 150 psig.
8) **Maximum Operating Temperature**: 240 deg F.

2.5 EXPANSION TANKS

A. Manufacturers:
1. Taco
2. Bell & Gossett
3. Wessels

B. An expansion tank shall be provided for the chilled water system. The expansion tank shall be as noted/shown on plans as a pre-charged steel hydro pneumatic tank with replaceable heavy-duty rubber bladder. The unit shall be constructed in accordance with Section VIII of the ASME boiler and pressure vessel code and stamped 125 PSIG design pressure. The expansion tank shall be sized based on total volume of water in system.

2.6 AIR SEPARATORS

A. Manufacturers:
1. Taco.
2. Bell & Gossett
3. Weinman

B. Furnish and install air and dirt removal devices of the size and type as noted/shown on the plans, for the ground loop and heating hot water system. Air and dirt separation devices shall be of size and capacities noted on drawings.

C. Air and dirt removal devices shall be constructed of steel design and fabricated per ASME Section VIII Division I with a maximum working pressure rating of 125 (150) psi at 270º F. Units up to 3-inch in size shall be provided with a threaded system connections. Units 4-inch and larger shall be provided with a flange system connections as standard.

D. Each air and dirt separator shall be equipped with a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. A brass flushing cock shall be located on the side of each separator to facilitate system fast-fill and the removal of floating impurities from the air system interface within the separator. The unit manufacturer shall provide a blow down valve on the bottom of each air/dirt separator to allow cleaning as required.

E. The air and dirt separator shall employ the use of high surface pall rings to achieve optimal separation of gas and dirt. The supplier of the air and dirt separator shall furnish to the design engineer the results of independent air and dirt testing of a representative unit from the supplier standard product offering. Suppliers not providing these independent performance test results will not be accepted.

2.7 STRAINERS

A. Size 2 inch and Under:

1. Manufacturers:

a. Mueller.

b. Grinnell.

c. Fisher.

2. Screwed brass or iron body for 125 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:

1. Manufacturers:

a. Mueller.

b. Grinnell.

c. Fisher.

2. Flanged iron body for 125 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

PART 3-EXECUTION

3.1 INSTALLATION

A. Provide piping expansion joints with piping control guides to control the expansion of the water piping systems where piping expansion loops cannot be used because of space restrictions.

B. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement

is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connection or apparatus.

C. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offset, and swing joints, or expansion joints where indicated.

D. Provide ASME safety relief valve in all closed hydronic loop systems. Relief valves shall be sized for the proper relief capacity to protect each system.

E. Provide manual air vent valves at all coils, at the high points of each system, and as shown.

F. Provide automatic air vent valves on the air separator for each system. Pipe this air relief discharge to the nearest floor drain.

G. Provide an ASME bladder type expansion tank for each closed loop system as noted/shown.

H. Provide strainers as noted/shown.

END OF SECTION 23 05 16

SECTION 23 05 19

METERS AND GAUGES FOR HVAC PIPING

PART 1-GENERAL

1.1 SECTION INCLUDES

A. Thermometers and fittings.

B. Pressure gauges and fittings.

1.2 SUBMITTALS

A. Submit shop drawings and product data per applicable Division I Specification.

B. Shop drawings shall include product data noting materials, sizes, and dimensions.

PART 2-PRODUCTS

2.1 MANUFACTURERS

A. Trerice

B. Ashcroft

C. Neiss

2.2 COMPONENTS

A. Thermometers: 1-percent accuracy.

1. Adjustable angle stem, cast aluminum case, acrylic magnifying lens, graduated aluminum scale, reversible mounting flange for duct application, 1.25”-18 UNEF-2A coupling nut for pipe well insertion. 7”, 9” or 12” size, but must be easily readable from the floor.
2. Non-toxic, organic spirit filled liquid-in-gas, column type thermometer.

B. Pressure Gauges: Phosphor-bronze Bourdon-tube gages, 1-percent accuracy.

1. Pressure Range: Two-times operating pressure.
2. Liquid filled pressure gauge where appropriate.

PART 3-EXECUTION

3.1 INSTALLATION

A. Provide thermometers in wells as shown on the drawings.

B. Provide pressure gauges at the following locations:

1. Inlet and outlet piping of each hydronic AHU coil.
2. As otherwise shown on the drawings.

END OF SECTION

SECTION 23 05 23

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1-GENERAL

1.1 SECTION INCLUDES

A. Valves

1.2 SUBMITTALS

A. Submit shop drawings and product data per applicable Division I Specifications.

B. Shop drawings shall include product data noting type materials, sizes, and dimensions.

1.3 QUALITY ASSURANCE

A. The following standards apply.

1. ANSI B16.10, MSS SP-67-90 Butterfly Valves.
2. MSS SP-78-92 Cast Iron Plug Valves Flanged and Threaded.
4. MSS SP-80-87 Bronze Globe and Check Valves.
5. MSS SP-85-85 Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
6. MSS SP-110-92 Ball Valves Threaded, Socket-Welded, Solder Joint, Grooved and Flanged Ends.

PART 2-PRODUCTS

2.1 COMPONENTS

A. Ball Valves

1. Manufacturers:

a. Nibco
b. Hammond
c. Apollo
d. Milwaukee
e. Victaulic

2. Bronze body and bonnet, two-piece construction, chrome-plated ball, standard port for 2-1/2 inch NPS and smaller and full port for 3 inch NPS valves, Class 150, with stem extensions for insulated piping and memory stops.
3. Ductile-iron grooved end body, two-piece construction, chrome-plated carbon steel ball and stem, standard port, TFE seats and Fluoro-elastomer seals, lever handle or gear operator, 800 psig CWP.

B. Plug Valves

1. Manufacturers:

a. Nibco

b. Hammond
c. Apollo
d. Milwaukee
e. Victaulic

2. Grooved end eccentric type plug valves with ductile iron body and elastomer coated ductile iron plug, 175 psig with lever handle or gear operator. This valve shall only be used for water systems with a maximum operating temperature of 230 degrees F.

C. **Butterfly Valves:** Cast-iron body and bonnet, Class 250, 200 psig working pressure, stainless-steel stem; lug, or grooved style connections. (For HVAC systems only)

1. Manufacturers:
a. Nibco
b. Hammond
c. Apollo
d. Milwaukee
e. Victaulic

1. **Disc Type:** Aluminum bronze

2. Grooved end butterfly valve with ductile iron body and nickel-coated ductile iron disc, 300 psig working pressure, offset disc to provide continuous 360 degree seating.

3. Operator:
a. Standard lever handle.
b. Standard lever handle with memory stop.
c. Lever handle with latch lock.
d. Gear with position indicator.
e. Gear with position indicator and chain wheel.
f. Chain wheel.

D. Check Valves

1. Manufacturers:
a. Nibco
b. Hammond
c. Apollo
d. Milwaukee
e. Victaulic

2. Swing Type, 2-1/2 Inch NPS and Smaller: Bronze body, Class 125 or 150, horizontal swing, with threaded or soldered connections.

PART 3-EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges, grooved couplings, or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

A. Install all threaded valves with a union joint on the downstream side of the valve.

B. Provide valves to isolate all equipment and coils on the supply and return pipes.

C. Provide valves of like material as the piping systems.

D. Provide dielectric waterway connections between all dissimilar metals.

E. Install valves with stems upright or horizontal not inverted.

F. Grooved end valves shall be installed in accordance with the manufacturer's guidelines and recommendations. To assure uniformity and compatibility all grooved end valves and adjoining couplings shall be supplied by same manufacture. Grooved end shall be clean and free from indentations and projections. A manufacturers factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved end valves. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

END OF SECTION

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SECTION 23 05 25

HYDRONIC HVAC FLOW CONTROL

PART 1-GENERAL

1.1 SECTION INCLUDES

A. Calibrated plug/balancing/circuit setter type valves for manual system flow balancing.

1.2 SUBMITTALS

A. Submit shop drawings and product data per applicable Division I Specification.

B. Shop drawing shall include product data noting materials, sizes, and dimensions.

PART 2-PRODUCTS

2.1 MANUFACTURERS

A. IMI Flow Designs
B. Tour and Anderson
C. Griswold
D. Taco

2.2 CALIBRATED PLUG/BALANCING/CIRCUIT SETTER TYPE VALVES

A. 125 psig maximum working pressure 250 degrees F maximum operating temperature, bronze construction with ball valve, calibrated nameplates, tamper resistant memory stop, calibrated venturi orifice for up thru 2", cast iron body with calibrated venturi orifice for sizes 2.5" thru 4", Taco ACCU-FLO or equal. Provide with pressure temperature taps. Two inches diameter and smaller shall have threaded connections. Two and one-half inches diameter and larger shall be flanged connections.

PART 3-EXECUTION

3.1 INSTALLATION

A. Provide valves specified herein at each chiller and/or dehumidifier, and as otherwise shown, detailed or as required to properly balance the flow to each device requiring same.

END OF SECTION

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SECTION 23 05 29

HVAC EQUIPMENT HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 **SECTION INCLUDES**

A. Pipe and equipment hangers, supports and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 **SUBMITTALS**

A. Submit shop drawings and product data per applicable Division I Specification.

B. Shop drawings are required and shall include product data noting materials, sizes, and types.

PART 2-PRODUCTS

2.1 **MANUFACTURERS**

A. PHD (Basis of Design)
B. Pentair/Caddy
C. Grinnell
D. Anvil
E. Empire Industries

2.2 **PIPE HANGERS AND SUPPORTS FOR NON-CORROSIVE AREAS**

A. Hangers, supports, and components shall be factory fabricated according to MSS SP-58, the latest edition.

B. Hangers for piping shall be of a compatible material or coating.

C. Continuous threaded rod shall be used wherever possible. Chain, wire, or perforated straps shall not be permitted. Rod and fasteners to be same material as hangers.

D. Concrete inserts into poured concrete floor systems are permitted.

E. Supports from roof decking systems are not permitted.

F. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.

G. Hangers for Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis.

H. Multiple of Trapeze Hangers: Steel channels with welded spacers and hanger rods.

I. Wall Support for Pipe Sizes 3 Inches: Carbon steel.

J. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

K. Vertical Support: Steel riser clamp.

L. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

M. Copper Pipe Support: Carbon steel ring, adjustable, copper plated or plastic coated.

N. Piping Across Roof: Install on equipment support rails with roller supports, all suitable for outdoor installation.

O. Concrete inserts into precast concrete plank are permitted.

P. Powder activated fasteners are not allowed.

2.3 PIPE HANGERS AND SUPPORTS FOR CORROSIVE AREAS

A. Hangers, supports, and components shall be factory fabricated according to MSS SP-58, the latest edition, they shall meet the other general parts of paragraph 2.2, but they (and all associated rods, fasteners, etc.) shall be type 304 or 316 stainless steel. See PART 3 for a listing of corrosive areas.

2.4 HANGER RODS (For non-corrosive areas)

A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.5 INSERTS

A. Inserts: Malleable iron, case of galvanized steel sheet and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.6 SLEEVES

A. Sleeves for Pipes Through Non-Fire Rated Floors: Form with 18 gage galvanized steel for non-corrosive areas, 316 stainless steel for corrosive areas.

B. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 16 gage galvanized steel for non-corrosive areas, 316 stainless steel for corrosive areas.

C. Sleeves For Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Round Ductwork: Form with galvanized steel for non-corrosive areas, 316 stainless steel for corrosive areas.

E. Sleeves for Rectangular Ductwork: Form with galvanized steel for non-corrosive areas, 316 stainless steel for corrosive areas.

F. Stuffing or Fire Stopping Insulation: Glass fiber type, non-combustible.

2.7 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported piping.

2.8 FINISH

A. Prime coat exposed carbon steel hangers and supports. Hangers and supports located in suspended ceiling spaces are not considered exposed.

PART 3-EXECUTION

3.1 PIPE HANGERS & SUPPORTS

A. All hangers and supports shall be attached to the building structural system/elements, in coordination with the GC.

B. Support from steel joist panel point is required, when joist panels are in place.

C. All hangers, supports, and fastening methods used shall be suitable for the weight of the components being supported.

D. Support horizontal piping as follows:

	Spacing	Rod Size
1/2 to 1-1/4 inch	6'-6"	3/8"
1-1/2 to 2 inch	10'-0"	3/8"
2-1/2 to 3 inch	10'-0"	1/2"
4 to 6 inch	10'-0"	5/8"
PVC - 3/4 to 1 inch	4'-0"	3/8"
PVC - 1-1/4 to 1-1/2 inch	4'-0"	3/8"
PVC - 2 to 2-1/2 inch	4'-0"	3/8"
PVC - 3 to 4 inch	4'-0"	1/2"

E. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

F. Place a hanger within 12 inches of each horizontal elbow.

G. Use hangers with 1-1/2 inch minimum vertical adjustment.

H. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

I. Support riser piping independently of connected horizontal piping. Support vertical pipe per code.

3.2 EQUIPMENT BASES AND SUPPORTS

A. Set steel bases for 1 inch clearance between housekeeping pad and base.

B. Set concrete inertia base for 2 inch clearance between housekeeping pad and base.

3.3 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing or fire stopping insulation and seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

D. Install chrome plated steel escutcheons at finished surfaces.

3.4 PROJECT CORROSIVE AREAS

A. The areas/buildings considered corrosive for this project areas as follows: Filter rooms, fluoride and fluoride observation, and aerator access areas.

END OF SECTION

SECTION 23 05 30

THROUGH PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Penetrations through fire-resistance-rated vertical assemblies.
2. Penetrations through fire-resistance-rated horizontal assemblies.
3. Penetrations through smoke barriers and smoke partitions.

B. Related Sections

4. Division 1 – General Requirements.
5. Division 3 – Concrete.
6. Division 4 – Masonry.
7. Division 7 – Thermal and Moisture Protection.
8. Division 9 – Finishes.
9. Division 22 – Plumbing.
10. Division 23 – Heating Ventilating and Air Conditioning.
11. Division 26 – Electrical.
12. Division 27 – Communications.

1.2 REFERENCES

A. **American National Standards Institute (ANSI):**

1. ANSI/UL 263 - Fire Tests of Building Construction and Materials.
2. ANSI/UL 723 - Surface Burning Characteristics of Building Materials.
3. ANSI/UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.

B. American Society for Testing and Materials(ASTM):

1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
4. ASTM E 2174 - Standard Practice for On-Site Inspection of Installed Firestops.

C. Factory Mutual (FM) - FM4991 - Standard for Approval of Firestop Contractors.

D. International Code Congress (ICC):

1. International Building Code (IBC).
2. International Residential Code (IRC).
3. International Mechanical Code (IMC).
4. International Fire Code (IFC).
5. International Code Congress Evaluation Service (ICC ES).

E. National Fire Protection Association (NFPA):

1. NFPA 70 - National Electrical Code.

2. NFPA 80 – Standard for Fire Doors and Other Opening Protectives.
3. NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
4. NFPA 101 - Life Safety Code.
5. NFPA 5000 – Building Construction and Safety Code.

F. Underwriters Laboratories (UL) - UL Building Materials Directory:
1. Through-Penetration Firestops Systems (XHEZ).
2. Firestop Devices (XHJI).
3. Forming Materials (XHKU),
4. Wall Opening Protective Materials (CLIV).
5. Fill, Void or Cavity Materials (XHHW).

G.; American Society of Sanitary Engineering (ASSE):
1. ASSE Series 9000 – Professional Qualification Standard for Firestop Systems and Device Installers, Inspectors and Surveyors.

H. International Association of Plumbing and Mechanical Officials (IAPMO):
1. Uniform Plumbing Code (UPC).
2. Uniform Mechanical Code (UMC).

I. International Standards Organization (ISO):
1. ISO 6944.
2. ISO 10295-1: 2007.

1.3 PERFORMANCE REQUIREMENTS

A. Provide systems that are listed by at least one the following:
1. Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory".
2. Intertek Testing Service (Formerly known as Omega Point Laboratories), in "Directory of Listed Products".
3. Factory Mutual (FM), in FMRC Approval Guide.
4. Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.

B. Provide firestop products that are flexible enough to allow for pipe vibration in a through penetration application.

C. Provide products with the appropriate flame spread index and smoke develop index, when tested in accordance with ASTM E 84.

D. Provide products identical to those tested and listed for classification by UL, Intertek or any other qualified independent testing agency.

E. Provide products that bear classification marking of qualified independent testing agency.

F. Where firestop systems not listed by any listing agency are required due to project conditions, submit a substitution proposal with evidence specified.

G. Use only products specifically listed for use in listed systems.

H. Provide products that are compatible with each other, with the substrates forming openings, and with the items, if any, penetrating the firestopping, under the conditions represented by this project, based on testing and field performance demonstrated by manufacturer.

I. Firestopping materials must meet and be acceptable for use by all applicable codes cited in this section.

J. Provide products that meet the intent of the state or local and LEED ® guidelines on volatile organic compounds (VOC).

K. Where applicable provide products that meet the intent of the F rating classification for passage of flame per ASTM E 814 or ANSI/UL 1479 for through penetrations.

L. Where applicable provide products that meet the intent of the T rating classification for the transfer of temperature per ASTM E 814 or ANSI/UL 1479 for through penetrations.

M. Where applicable provide systems that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations.

N. Where applicable provide products that meet the intent of the W rating classification for passage of water per ANSI/UL 1479 for through penetrations.

1.4 SUBMITTALS

A. Submit under provisions of the Contract and Division 01 – General Requirements.

B. Shop Drawings: For each firestopping system, provide the following:

1. Listing agency's detailed drawing showing opening, penetrating item(s), and firestopping materials, identified with listing agency's name and number or designation and fire rating achieved.
2. For proposed systems that do not conform strictly to the listing, submit written instructions showing modifications and approved by firestop system manufacturer.
3. Submit under provisions of the International Building Code (IBC) section 703 requiring a submittal package for fire-resistance ratings and fire tests.

C. **Product Certificates:** Submit certificates of conformance signed by firestop system manufacturer certifying that materials furnished comply with requirements.

D. **Product Data:** Furnish manufacturer's product data sheets on each material to be used in firestop systems. Information on manufacturer's product data sheet should include:

1. Product characteristics including compliance with appropriate ASTM/UL/ANSI test standards.
2. Storage and handling requirements and recommendations.

E. **Installation Instruction:** Furnish manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

A. General: All through-penetration firestop systems shall be installed with approved methods using materials that have been tested and classified to produce an approved

assembly.

B. **Manufacturer Qualifications:** All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty five (25) years experience in passive fire protection.
   1. Products shall be manufactured in a facility that follows ISO 9001 best practices.
   2. Products shall have undergone a formal life cycle assessment evaluating environmental impact.

C. **Installer Qualifications:** Firm must be qualified by having experience, staff, and be properly trained to install the specified products, and meets the following criteria:
   1. Contractor is acceptable to manufacturer.
   2. Contractor is acceptable to Authority Having Jurisdiction (AHJ).
   3. Contractor has completed the manufacturer's certified product installation training.
   4. Contractor must provide a list of completed projects as evidence of experience; include project name and address, owner's name and address, and architect's name and phone number.
   5. Certificate: Contractor should provide certificate of qualification.

D. **Codes:** Where manufacturer's application procedures are in conflict with those of the local Authority Having Jurisdiction, the more strict guidelines will prevail.

E. **Pre-installation Meetings:** Meetings to agree on firestop requirements, conditions, manufacturer's instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products until ready for installation in manufacturer's original unopened packaging, legibly marked with manufacturer's name and product identification, date of manufacture, lot number, listing agency's classification marking, curing/dry time, and mixing instructions (if applicable) and MSDS reference number.

B. Store and handle in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants, and other causes; follow manufacturer's instructions.

C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local Authority Having Jurisdiction (AHJ).

1.7 PROJECT CONDITIONS

A. Coordinate construction and cutting of openings so that each particular firestop system may be installed in accordance with its listing, including sizing, sleeves, and penetrating items, L rating and manufacturer’s published STC rating.

B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install firestopping under environmental conditions outside manufacturer's absolute limits.

C. Provide ventilation as required by firestopping manufacturer, including mechanical ventilation if required.

1.8 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: 3M Fire Protection Products

B. Hilti Firestop Products

C. STI Firestop

Single Source: To maintain control and integrity of the firestop applications a single manufacturer should be used. Specific UL or approved listing agencies systems applicable to each type of firestop condition should be supplied by one manufacturer.

2.2 SCOPE/APPLICATION

A. Provide installed firestop products that limit the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roof/ceilings, and similar locations, restoring the integrity of the fire rated construction to its original fire rating.

B. Provide firestop systems listed for the specific combination of fire-rated construction, type of penetrating item, annular space requirements, and fire rating, and the following criteria:
   1. F-Rating: Equal to or greater than the fire-resistance rating of the assembly in which the firestopping will be installed.
   2. T-Rating: In habitable areas where penetrating items are exposed to potential contact with materials on exposed side(s) of rated assembly, T-rating must equal its F-rating.
   3. L-Rating: L-rating of 1 cfm per linear foot (5.5 cu m/h/m) maximum at ambient temperatures. For those applications that require air leaking protection.
   4. W-Rating: meets UL Water Leakage Test, W Rating – Class 1 requirements for systems tested and listed in accordance with ANSI/UL 1479.
   5. Wall Penetrations: Through penetration systems must be symmetrical, with the same rating from both sides of the wall. Membrane penetrations may be asymmetrical.
   6. Testing: Determine ratings in accordance with ASTM E 814 or UL 1479.

2.3 THROUGH PENETRATION FIRESTOP PRODUCTS

A. **3M Fire Barrier Cast-in-Place Devices:** Firestopping device for use prior to a concrete pour. Adjustable height with pull tabs, straight edge design for close

placement to walls and adjacent devices.
1. Fire Resistance: For use in 1, 2, or 3 hour fire-rated systems.
2. Locations: Horizontal assemblies only.

B. **3M Fire Barrier Ultra RC Pack:** One piece metal collar assembly encasing intumescent material for firestopping of pipes and cables through rated walls and floors.
1. Fire Resistance: For use in 1 or 2 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

C. **3M Fire Barrier Ultra Plastic Pipe Device:** Intumescent device for firestopping of plastic pipe and cables through rated walls and floors.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Configuration: One-piece metal collar, with locking latch and bendable tabs to secure; equipped also for conventional anchoring.
3. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

D. **3M Fire Barrier RC-1 Restricting Collar with either FS 195+ Wrap Strip or 3M Interam Ultra GS Wrap Strip. (See product descriptions below):** For firestopping of plastic pipes from 4 inches (102 mm) to 10 inches (254mm) in diameter.
1. Fire Resistance: For use in 1or 2 hour fire-rated systems.
2. Material: 28 gauge steel.
3. Size: 25 foot (7.6 m) roll.
4. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

E. **3M Fire Barrier CP25WB+ Sealant:** High-performance, intumescent, water-based sealant. No-sag, fast drying, paintable, red in color. Versatile firestop sealant for pipes (not for use with CPVC), cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
1. Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
3. STC rating of 54 when tested in STC 54-rated wall assembly.

F. **3M Fire Barrier IC 15WB+ Sealant:** General-purpose, intumescent, water-based sealant. No-sag, fast drying, paintable, yellow in color. Economical firestop sealant for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
3. STC rating of 54 when tested in STC 54-rated wall assembly.

G. **3M Fire Barrier Sealant FD 150+:** Single-part, water-based, acrylic latex sealant. No-sag, low-shrinkage, low VOC. Blue, red or limestone color. Used to firestop for pipe penetrations (not for use with CPVC).
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
3. STC rating of 54 when tested in STC 54-rated wall assembly.

H. **3M Fire Barrier Water Tight Sealant 3000 WT:** Single-part, water-tight, intumescent silicone firestop sealant for filling voids in concrete gypsum, metal, plastic, wood and insulation. Light gray color with black flecks. Meets UL Water

Leakage Test, W Rating – Class 1 requirements.
1. Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
3. STC rating of 53 when tested in STC 54-rated wall assembly.

I. **3M Fire Barrier Water Tight 1000 NS Sealant:** Single-part, non-slump firestopping silicone sealant for floor and wall openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
3. STC rating of 56 when tested in STC 56-rated wall assembly.

J. **3M Fire Barrier Water Tight Sealant 1003 SL:** Single-part, self-leveling firestopping silicone sealant for floor openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
2. Locations: For horizontal assemblies only.
3. STC rating of 56 when tested in STC 56-rated wall assembly.

K. **3M Fire Barrier Sealant 2000 NS:** Single-part, non-slump elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit and electrical wiring.
1. Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
2. Locations: Vertical and horizontal assemblies.
3. STC-Rating of 56 when tested in STC 56-rated wall assembly.

L. **3M Fire Barrier Sealant 2000+:** Single-part, elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit and electrical wiring.
1. Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
2. Locations: Vertical and horizontal assemblies.
3. STC-Rating of 56 when tested in STC 56-rated wall assembly.

M. **3M Fire Barrier Moldable Putty+:** One-part, 100 percent solids intumescent firestop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic formula. Versatile putty for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
1. Type: Stick or Pad
2. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
3. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

N. **3M Fire Barrier 2001 Silicone RTV Foam:** Two-part, liquid-silicone elastomer, foams in place when mixed. For use sealing large or complex openings such as cable bundles and cable trays.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

O. **3M Fire Barrier Mortar:** For sealing openings in concrete and masonry walls and

floors. Self Leveling, non-sag, low VOC.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

P. **3M Fire Barrier Self-Locking Pillow:** Self-contained, intumescent firestop pillow with interlocking strips. Meets fire rating without the use of wire mesh. For use in firestopping larger openings
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

Q. **3M Fire Barrier Pillow:** Self-contained, intumescent firestop product. Meets fire rating without the use of wire mesh. For use in firestopping larger openings
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

R. **3M Fire Barrier CS-195+ Composite Sheet:** Organic/inorganic intumescent elastomeric sheet, bonded on one side to a layer of 28 gauge galvanized steel. Other side reinforced with steel-wire mesh and covered with aluminum foil. Re-enterable. For use in firestopping larger openings
1. Thickness: Nominal 0.3 inch (7.6 mm).
2. Thermal Expansion: 8 - 10 times original size.
3. Tensile Strength (ASTM D412): 93.6 psi (645 kPa)/489 percent.
4. Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems..
5. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

S. **3M Interam Ultra GS Wrap Strip:** Graphite based, flexible, largely inorganic, intumescent mat. For use around non-metallic piping with or with RC-1 collar.
1. Fire Resistance: For use in 1, 2 or 3 hour fire rated systems..
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

T. **3M Fire Barrier FS-195+ Wrap/Strip:** One-part, organic/inorganic intumescent strip with foil on one side. May be cut to fit irregular shapes. For use around non-metallic piping with or with RC-1 collar.
1. Length: 24 inch (610 mm).
2. Width: 1 or 2 inches.
3. Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
4. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

U. **3M Fire Barrier Pass-Through Devices:** One-Piece device for firestopping of cable penetrations through rated walls and floors.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

V. **3M Fire Barrier Tuck-In:** Graphite-based, flexible, intumescent wrap strip for use around non-metallic piping. Adhesive closure tab.
1. Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

W. **3M Fire Barrier Putty Sleeve Kit:** Device used for firestopping of cable penetrations through fire rated walls and floors.
1. Fire Resistance: For use in 1, 2 3 or 4 hour fire-rated systems.
2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestopping.

C. Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.

D. Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of firestopping, including ducts, piping, equipment, and other suspended construction.

E. Verify that environmental conditions are safe and suitable for installation of firestopping.

F. If substrate preparation is the responsibility of another installer, notify Architect or Engineer of Record of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Prepare substrates in accordance with manufacturer's instructions and recommendations.

B. Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.

3.3 INSTALLATION

A. Install in strict accordance with manufacturer's detailed installation instructions and procedures.

B. Install so that openings are completely filled and material is securely adhered.

C. Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.

D. After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.

E. Repair or replace defective installations in accordance with manufacturer’s recommendations, listed systems details and applicable code requirements.

F. At each through penetration, attach identification labels on both sides in location

where label will be visible to anyone seeking to remove penetrating items or firestopping.

G. Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.

H. Notify Authority Having Jurisdiction (AHJ) when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.

I. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

3.4 FIELD QUALITY CONTROL

A. Owner will engage an independent testing agency to inspect installed firestopping and to prepare reports indicating whether the installed work complies with the contract documents.

B. Notify testing agency at least 7 days prior to date when firestopping installation will be ready for inspection; obtain advance approval of general schedule and phasing, if any, required to allow subsequent construction to proceed.

3.5 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. Install identification Labels for Through Penetration: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:
1. The words "Warning - Through Penetration Firestop System - Do not Disturb. Notify Building Management of Any Damage."
2. Listing agency's system number or designation.
3. System manufacturer's name, address, and phone number.
4. Installer's name, address, and phone number.
5. General contractor's name, address, and phone number (if applicable).
6. Date of installation.

END OF SECTION

SECTION 23 05 48

VIBRATION ISOLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install HVAC Systems.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with HVAC Systems.

C. This Section includes the following:

   1. Isolation pads.
   2. Isolation mounts.
   3. Housed spring mounts.
   4. Elastomeric hangers.
   5. Spring hangers.
   6. Pipe riser resilient supports.
   7. Resilient pipe guides.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

   1. Product Data for the following:

      a. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Delegated-Design Submittal: For vibration isolation details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

3. Welding certificates.

4. Field quality-control test reports.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

1.6 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ace Mountings Co., Inc.
   2. Mason Industries.
   3. Vibration Eliminator Co., Inc.
   4. VMC.
   5. Amber/Booth.
   6. Or equal.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   1. Verify availability of various pad materials with manufacturers.
   2. Resilient Material: Oil- and water-resistant neoprene, rubber, or hermetically sealed compressed fiberglass.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

F. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

G. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

H. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

I. For devices in corrosive areas, provide special construction to specifically resist same.

2.2 **FACTORY FINISHES**

A. Finish for Non-Corrosive Areas: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
   3. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

B. Finish for Corrosive Areas: Manufacturer's special coatings applied to factory-assembled and -tested equipment before shipping, to resist specific corrosive atmosphere where installed.
   1. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **APPLICATIONS**

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

3.3 **VIBRATION-CONTROL DEVICE INSTALLATION**

A. Comply with requirements in Division 7 for installation of roof curbs, equipment supports, and roof penetrations.

B. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

E. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 **FIELD QUALITY CONTROL**

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Obtain Engineer’s approval before transmitting test loads to structure. Provide temporary load-spreading members.
   3. Test at least two of each type and size of installed anchors and fasteners selected by Engineer.
   4. Test to 90 percent of rated proof load of device.
   5. Measure isolator deflection.
   6. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 **ADJUSTING**

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 05 53

HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install mechanical identification.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with mechanical identification.

1.3 QUALITY ASSURANCE

A. Reference Standards: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASME A 13.1 – Scheme for identification of piping systems.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: 304 stainless steel; screen printed; 0,015-inches thick, permanently attached to the equipment.
   1. Data:
      a. Manufacturer, product name, model number, and serial number.
      b. Capacity, operating and power characteristics, and essential data.
      c. Labels of tested compliances.
   2. Location: Accessible and visible.
   3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type permanent adhesive.
   1. Terminology: Match schedules as closely as possible.

2. Data:
    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-½ by 4 inches for control devices, dampers, and valves; 4-½ by 6 inches for equipment.

C. Access Panel and Door Markers: 1/16-inch thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Manufacturer's standard preprinted captions.
3. Pipes with OD, Including Insulation, Less Than 6-Inches Full-band pipe markers extending 360 degrees around pipe at each location.
4. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pre-tensioned Pipe Markers: Pre-coiled semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Performed semi rigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners what do not penetrate insulation vapor barrier.

2.3 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction of airflow and duct service (such as make-up air, supply air, and exhaust air). Include contact-type, permanent adhesive.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4-inches for ducts; and minimum letter height of ¾-inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
1. Stencil Material: Fiberboard.
2. Stencil Paint: Exterior, gloss alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

2.5 **VALVE TAGS**

A. Valve Tags: Stamped or engraved with ¼-inch letters for piping system abbreviation and ½-inch numbers, with numbering scheme approved by ENGINEER. Provide 5/32-inch hole for fastener.
   1. Material: 0.032-inch thick brass.
   2. Material: 0.0375-inch thick, type 304 stainless steel.
   3. Material: 3/32-inch thick laminated plastic with two black surfaces and white inner layer.
   4. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 **WARNING TAGS**

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7-inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NO OPERATE.
   4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 **APPLICATIONS, GENERAL**

A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 **EQUIPMENT/PANEL IDENTIFICATION**

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment and panel that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
   1. Heating and ventilating units and rooftop units.
   2. Fans, and primary balancing dampers.
   3. Ventilators/fans.
   4. Ductless split units and associated condensing/heat pump units.
   5. Heaters.
   6. HVAC/temperature control panels and remote operating stations.
   7. HVAC related VFD's.
   8. Dehumidifiers and chillers.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
   1. Letter Size: Minimum ¼-inch for name of units if viewing distance is less than 24-inches ½-inch for viewing distances up to 72-inches and proportionately larger let-

tering for greater viewing distances. Include secondary lettering 2/3 to ¾ the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units. Indicate unit's synergen number.
3. Locate markers where accessible and visible.

C. Stenciled Equipment Marker Option: Stencils markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

D. Install equipment signs with screws or permanent adhesive on or near each major items of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in standard colors that are directed by the plant.
2. Letter Size: Minimum ¼-inch or name of units in viewing distance is less than 24-inches, ½-inch for viewing distances up to 72-inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering 2/3 to ¾ the size of principal lettering.
3. Data: Indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

F. Install access panel markers with screws on equipment access panels.

3.3 **PIPING IDENTIFICATION**

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6-Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1½-inches wide lapped at least 1½-inches at both ends of pipe marker, and covering full circumference of pipe.

B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers complying with ASME A13.1 on each piping system.
1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe markers and color bands where piping is exposed in finished spaces: machine rooms; accessible maintenance spaces and exterior non-concealed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations thorough walls, floors, ceilings, and non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive on metallic air ducts in standard colors as directed by the plant.
   1. Letter Size: Minimum ¼-inch for name of units if viewing distance is less than 24-inches, ½-inch for viewing distances up to 72-inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering 2/3 to ¾ the size of principal lettering.

B. Stenciled Duct Marker Option for Metallic Ducts, and Required for FRP Ducts.: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate markers/stencils near points where ducts pass to other spaces and at maximum intervals of 50-feet in each space where ducts are exposed.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves and valves within factory-fabricated equipment units.

3.6 WARNING-TAG INSTALLATION

A. Print require message on, and attach warning tags to, equipment and other items where required. Tags shall meet the requirements of the plant.

3.7 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

A. Clean faces of mechanical identification devices/markers/stencils.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope:**
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to properly test, adjust, and balance the project HVAC equipment/systems.

1.3 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. **TAB Conference**: Meet with Architect/Engineer's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
   1. **Agenda Items:** Include at least the following:
      a. Submittal distribution requirements.
      b. The Contract Documents examination report.
      c. TAB plan.
      d. Work schedule and Project-site access requirements.
      e. Coordination and cooperation of trades and subcontractors.
      f. Coordination of documentation and communication flow.

C. **Certification of TAB Reports:** Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. **TAB Report Forms:** Use standard forms from TAB firm's forms approved by Architect/Engineer.

E. **Instrumentation Calibration:** Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.4 **SUBMITTALS**

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Data Forms:

a. Submit data forms on each item of testing equipment required. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.

b. All field data pertaining to each item of equipment being tested must be tabulated and submitted on the standard forms of NEBB or AABC.

c. The CONTRACTOR shall sign and date each form in the space provided and proof of certification shall accompany the final report.

2. **Report Forms:**

a. Submit specimen copies of report forms for ENGINEER's approval.

b. Forms shall be 8-1/2 by 11-inch paper for loose leaf binding, with blanks for listing of the required test ratings and for certification of report.

c. Reports shall be on the organizations approved forms imprinted with the company's name.

d. Certified report outlining procedure used to balance the system and the types of measuring devices used.

3. Test results shall be submitted on approved forms in a typed format.

4. Submit certified copies of required test reports to the ENGINEER for approval.

5. Instrument calibration reports, to include the following:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

1.5 **WARRANTY**

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

1.6 **DEFINITIONS**

A. Adjust: To regulate air and fluid flow rates and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. **Procedure:** An approach to and execution of a sequence of work operations to yield repeatable results.

G. **Report Forms:** Test data sheets for recording test data in logical order.

H. **TAB:** Testing, adjusting, and balancing.

I. **Test:** A procedure to determine quantitative performance of systems or equipment.

J. **Testing, Adjusting, and Balancing (TAB) Firm**: The entity responsible for performing and reporting TAB procedures.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on systems have been satisfactorily completed.

1.8 JOB CONDITIONS

A. Heating, ventilating, air conditioning equipment shall be completely installed and in continuous operation as required to accomplish the test, adjust and balance work specified.

B. Test, adjust and balance shall be performed when outside conditions approximate design conditions indicated for heating and cooling functions.

1.9 OPERATING INSTRUCTIONS

A. Reports shall be certified by the CONTRACTOR that the methods used and the results achieved are as specified.

1.10 **BALANCE INSTRUMENTATION**

A. CONTRACTOR shall provide all necessary instrumentation, tools, ladders, etc. to complete all air balancing tests and adjustments.

B. Instrumentation shall be in accordance with NEBB or AABC requirements and shall be calibrated to the accuracy standards stipulated by these organizations.

C. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling grille, register, and diffuser performance only.

D. CONTRACTOR shall assume full responsibility for safe keeping of all instrumentation during the course of work.

1.11 **CORRECTIVE ADJUSTMENTS**

A. Should corrective measures caused by faulty installation require retesting, adjusting and balancing, such work shall be at no additional expense to the OWNER.

B. Inspections:

1. Fan Belt Deflection: No less than 1/4-inch or more than a 1/2-inch.
2. Finned Coils: Fins shall be combed out with a fin comb for appropriate fin spacing. Helical fins shall be straightened with blunt bladed instrument.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 **GENERAL**

A. Testing, adjusting, and balancing of air and hydronic systems shall be performed in compliance with the standard procedure manual published by the testing, adjusting, and balancing organization affiliated with the CONTRACTOR. CONTRACTOR shall submit one copy of the standard procedure manual to the ENGINEER for record purposes only.

B. CONTRACTOR shall be solely responsible for the protection and safeguarding of his work and shall provide every protection against accidents, injury, and damage to persons and property.

C. CONTRACTOR shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day.

D. CONTRACTOR shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.

E. CONTRACTOR shall install additional access panels at no extra cost to the OWNER, as is required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.

F. Air systems shall be tested, adjusted, and balanced with clean filters and hydronic systems with clean strainers.

3.2 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Pre-Startup Inspection:

1. Verify proper equipment mounting and setting.
2. Verify that control, interlock and power wiring is complete.
3. Verify alignment of motors and drives.
4. Verify proper piping connections and accessories.
5. Verify that lubrication is completed.

C. First Run Observations:

1. Verify direction of rotation.
2. Verify setting of safety controls.
3. Monitor heat build-up in bearings.
4. Check motor loads against nameplate data.

D. Equipment Check:

1. Verify proper overload heater sizes.
2. Verify function of safety and operating controls.
3. Verify proper operation of equipment.
4. Report on inspection, observation and checking procedures.

3.3 AIR SYSTEMS

A. Preliminary:

1. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.

B. Central Systems:

1. Test rpm for all equipment, including adjust each fan, and air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
2. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.
3. Make pitot tube traverse of main supply, exhaust and return ducts, determine cfm at all fans and units and adjust fans and units to within 5 percent of design requirements.
4. Test and record system suction and discharge static pressure.
5. Test and adjust system for design outside air cfm.
6. Test and adjust system for design recirculated air cfm.
7. Test and record heating apparatus outdoor entering air temperatures, dry bulb.
8. Test and record heating apparatus return air temperatures, dry bulb.
9. Test and record heating apparatus mixed air temperatures, dry bulb.
10. Test and record heating apparatus leaving air temperatures, dry bulb.

11. Test and record cooling apparatus outdoor entering air temperatures, dry bulb and wet bulb.
12. Test and record cooling apparatus return air temperatures, dry bulb and wet bulb.
13. Test and record cooling apparatus mixed air temperatures, dry bulb and wet bulb.
14. Test and record cooling apparatus leaving air temperatures, dry bulb and wet bulb.
15. Record all fan and air handling unit speeds.
16. Record air quantity delivered by each fan and air handling unit.
17. Test, adjust, and record all airside (including reactivation air) data for the new dehumidification unit.

C. Distribution:

1. Adjust volume dampers, control dampers, splitter dampers, air extractors, etc. to proper design cfm in main ducts, branch ducts, and zones.

D. Verification:

1. Prepare summation of readings of observed cfm for each system, compared with required cfm, and verify that duct losses are within specified allowable range.
2. Verify design cfm at fans as described above.
3. If the air systems are not properly balanced, CONTRACTOR shall rebalance and recheck all data in the presence of ENGINEER and as approved by him.

3.4 HYDRONIC SYSTEMS

A. Preliminary:

1. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.

B. Central Systems:

1. Test rpm for all equipment, including adjust each pump/chiller/coil to design requirements within the limits of mechanical equipment provided.
2. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.
3. Test and record all system flows, temperatures, pressures, and pressure drops.

C. Distribution:

1. Adjust valves and equipment to proper design flows.

D. Verification:

1. Prepare summation of readings of observed flows and pressures for each system, compared with required performance.

3.5 PROCEDURES FOR MOTORS

A. **Motors, 1/2 HP and Larger:** Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.

5. Nameplate and measured voltage, each phase, 100% speed.
6. Nameplate and measured amperage, each phase, 100% speed.
7. Starter thermal-protection-element rating.
8. Current limit setting on Variable Frequency Drive.
9. Minimum speed setting on Variable Frequency Drive.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation, if so equipped. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.6 PROCEDURES FOR CONDENSING/COMPRESSOR SECTIONS OF AIR CONDITIONING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.7 PROCEDURES FOR HEAT-TRANSFER COILS/HEAT EXCHANGERS

A. Measure, adjust, and record the following data for each coil/heat exchanger:

1. Entering- and leaving-air temperature.
2. Unit airflow rate.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

3.8 HVAC SYSTEM AIRFLOW RATE TOLERANCES

A. Supply, Make-up, and Exhaust: Zero to plus 5 percent (and required pressurizations must be maintained).

3.9 OTHER HVAC COMPONENTS/UNITS/SYSTEMS

A. Test and balance per AABC NEBB standard procedures and record/report required data.

3.10 AUTOMATIC CONTROL SYSTEMS

A. In cooperation with the control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.

B. CONTRACTOR shall verify all controls for proper calibration and operation and list those controls requiring adjustment by control system installer.

3.11 SYSTEM PERFORMANCE REPORT

A. After the conclusion of balancing operations, make temporary installation of portable recorders and simultaneously record temperatures and humidities during summer and winter conditions at representative locations in each system inside and outside of building.

B. Test locations shall be as approved by ENGINEER.

C. Recordings shall be made during summer and winter seasons for a 7-day period, continuous over a weekend, and including at least one period of operation at outside conditions within 5 degrees F wet bulb temperature of maximum summer design condition and within 10 degrees F dry bulb temperature of minimum winter design condition. Design conditions shall be based on ASHRAE 2 1/2 percent weather data.

D. Report of test results shall include original recording and two reproductions.

3.12 MAINTENANCE AND REPAIR

A. Maintenance and Repair:

1. Provide all labor, tools and equipment to provide a preventive maintenance program. Make repairs for all equipment and controls for a one year period after final acceptance by OWNER. CONTRACTOR shall provide the following services for the same one year period.
    a. Receive calls for all problems and take steps to immediately correct deficiencies which may exist.
    b. Provide a monthly inspection of all equipment, and record the findings on a check list hereinafter specified.
    c. Provide a preventive maintenance schedule for the principle items of equipment.

B. Check List:

1. Provide a check list and post a copy of it where directed by OWNER.
2. Include each piece of equipment specified or shown.
3. Provide 12 columns for required monthly inspections.
4. Provide columns for the following:
    a. Equipment condition.
    b. Equipment operation.
    c. Equipment lubrication.
    d. Preventive maintenance.
        1. Preventive maintenance shall be performed in accordance with the manufacturers recommendations and accepted practice.

3.13 TRAINING

A. CONTRACTOR shall provide the necessary skilled labor for operating all the systems and equipment during the appropriate season for which the respective pieces of equipment are in operation and conduct an instruction period of not less than two 8-hour days for the plant operating personnel, as designated by OWNER. They shall be instructed fully in the operations, adjustment

and maintenance of all equipment and controls. At least 48 hours advance notice shall be provided prior to instruction period, excluding Saturdays, Sundays and holidays. Informal or unwitnessed instructions or instructions to non-designated personnel will not be recognized by OWNER.

END OF SECTION

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SECTION 23 07 00

HVAC INSULATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Qualitative requirements for exterior pipe and pipe specialty/equipment insulation, jacketing and accessories.

B. Qualitative requirements for exterior duct, plenum, and equipment insulation, jackets, and accessories.

1.2 SUBMITTALS

A. Submit shop drawings and product data per applicable Division I Specification.

B. Submittals are required and shall include product data noting materials, thickness for each service, aged thermal qualities, and accessories.

1.3 QUALITY ASSURANCE

A. Fire performance characteristics in accordance with ASTM E 84 for flame spread of 25 and smoke developed of 50.

B. Materials and installation in accordance with NFPA 255 and UL 723.

C. Installed R-value shall meet the requirements of ASHRAE Standard 90.1, this specification, and they shall be provided to eliminate condensation, whichever requires a greater R-value.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Pipe and Pipe Specialty/Equipment Insulation

a. Owens Corning
b. Johns Manville (Manville)
c. Knauf

B. Duct and Equipment Insulation

a. Owens Corning
b. Johns Manville (Manville)
c. Knauf
d. Certainteed Corporation

2.2 MATERIALS

A. **Mineral Fiber:** With ASJ jacket (unless noted otherwise) and with vapor-barrier.

a. Preformed Pipe Insulation: ASTM C 547, Class I, rigid, minimum density to be 5.5 pcf.
b. Board Insulation: ASTM C 612, Type 2, rigid and semi-rigid. Minimum density to be 6 pcf. Owens Corning 705 or equal.
c. Blanket: ASTM C 553, Type II, Class F-1, with FSK vapor barrier jacket, minimum density to be 1 pcf, Owens Corning Type 100 SOFTR Duct Wrap FRK or equal.
d. Adhesive: UL Classification; Nonflammable, and as recommended by insulation manufacturers.
e. Pre-formed Pipe and Tank Insulation: ASTM C1393, Owens Corning Fiberglas Pipe and Tank with ASJ Max jacket
f. **Maximum "K" Value:** 0.27 at 75 degrees F.

B. Insulating Cements

a. Mineral fiber, hydraulic-setting insulating and finishing cement.
b. Expanded or exfoliated vermiculite.
c. Must be compatible with insulation/jacket.

C. **Adhesives:** MIL-A-3316C, Classes 1 and 2, Grade A, and must be compatible with insulation/jacketing.

D. Field applied jackets shall be as follows:

a. Jacketing for Insulated Outdoor Ductwork and Piping: Self-adhesive, 3M Ventureclad 1579GCW Insulation Jacketing, or equal, zero permeability vapor barrier, minimum 140 lb/inch tensile strength, aluminum outside color. Install and seal per manufacturer's instructions.

E. Products shall not contain asbestos, lead, mercury, or mercury compounds.

F. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

G. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's recommendations and in conformance with the in-force building and mechanical codes and industry standards.

B. Where a vapor barrier is called for, it shall be continuous.

C. Provide proper support, insulation, and finishing at hanger systems.

D. Ductwork shall be externally insulated.

E. Insulated cold pipes and equipment conveying fluids below ambient temperature:

a. Provide vapor barrier jackets, factory applied where possible, field applied otherwise.
b. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
c. Finish fitting insulation with preformed PVC fitting covers and vapor barrier adhesive.

d. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
e. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
f. At supports, hangers, and shields, install insulation with high density insulation inserts.

F. Insulated ductwork conveying air below ambient temperature:

a. Provide insulation with factory applied vapor barrier jackets.
b. Finish with compatible and matching tape and vapor barrier jacket.
c. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
d. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

G. Insulated ductwork conveying air above ambient temperature:

a. Provide factory applied jacket, with or without vapor barrier, and finish with matching compatible tape.
b. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

H. Finish insulation at supports, protrusions, and interruptions.

I. All duct insulation shall be applied so that there is no fiberglass exposed to any air streams without filters downstream. All fiberglass insulation, including all exposed edges, shall be coated with a suitable, ASHRAE 62.1 rated, material provided between fiberglass and the air stream.

J. Following items are not insulated:

a. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
b. Vibration control devices.
c. Testing laboratory labels and stamps.
d. Nameplates and data plates.
e. Factory insulated access panels and doors in air distribution systems.
f. Factory insulated equipment such as boilers.

3.2 INSULATION AND FINISH JACKETING REQUIREMENTS

A. **Rectangular DH-1 Supply, Return, and Fresh Air Intake Ducts in Equipment Rooms:** Insulate with 1" thick rigid fiberglass board with factory ASJ jacket (equal to Owens Corning 705). Impale insulation on pins as recommended and hold caps after coating with mastic to provide a vapor seal. All insulation edges and joints are to be sealed. Vapor barrier to be created.
B. **Rectangular RTU Supply and Return Air Ducts Outdoors:** Insulate with fiberglass board with ASJ vapor barrier jacket to a finished total R value of 12. Vapor barrier to be created. Insulation on tops of ducts to be tapered for water run-off.
C. **RTU Supply and Return Air Ducts Indoors and Concealed:** Insulate with 1.5" thick FSK faced fiberglass blanket insulation. Vapor barrier to be created.
D. **RTU Supply and Return Air Ducts Indoors and Exposed:** Insulate with 1" thick rigid fiberglass board with factory ASJ jacket (equal to Owens Corning 705). Impale insulation on pins as recommended and hold caps after coating with mastic to provide a vapor seal. Vapor barrier to be created.
E. **Rectangular exhaust air ducts outdoors:** Insulate with 2" thick fiberglass board with ASJ vapor barrier jacket. Vapor barrier to be created. Insulation on tops of ducts to be tapered for water run-

off.

F. **CHW piping:** ASJ jacketed mineral fiber pipe insulation, minimum 1" thickness, or if more thickness needed to avoid condensation. Vapor barrier to be created.

G. **Outdoor HV Unit Supply Air:** Insulate with fiberglass board with ASJ vapor barrier jacket to a finished total R value of 12. Vapor barrier to be created. Insulation on tops of ducts to be tapered for water run-off.

H. **Indoor HV-1, 2, 4, and 5 Supply Air:** Insulate with 1" thick rigid fiberglass board with factory ASJ jacket (equal to Owens Corning 705). Impale insulation on pins as recommended and hold caps after coating with mastic to provide a vapor seal. All insulation edges and joints are to be sealed. Vapor barrier to be created.

I. **Indoor Exhaust Air Within 10' of the Outdoors:** Insulate with 1.5" thick FSK faced fiberglass blanket insulation. Vapor barrier to be created.

J. **DH-1 Reactivation Air Discharge**: Insulate with 2" thick fiberglass board/fiberglass pipe-and-tank insulation with ASJ vapor barrier jacket. Vapor barrier to be created.

K. **DH-1 Reactivation Air Intake from the Outside:** Insulate with 1.5" thick FSK faced fiberglass blanket insulation. Vapor barrier to be created.

L. **Cold Mechanical Equipment/Components:** ASJ jacketed mineral fiber insulation, same thickness as adjoining pipe. Vapor barrier to be created.

O. Provide field applied insulation protective jacketing for all insulated items outdoors using specified self-adhesive 3M Ventureclad jacketing.

END OF SECTION

SECTION 23 09 00

HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, devices, wiring, and incidentals as shown, specified and as required to furnish and install HVAC instrumentation and control systems.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with HVAC instrumentation and control systems.

C. Summary

1. This Section includes control equipment for HVAC instrumentation and control systems and components.

2. See Division 26 for general requirements for conduits, wiring, ratings, etc.

3. See Division 23 Section "Sequence of Operation" for other requirements that relate to this Section.

4. **Special Requirements:** For all buildings/areas that may be classified and/or that are deemed corrosive on this project, all HVAC instrumentation and controls work in those areas shall be properly rated/constructed/enclosed to meet the classifications of the areas and/or to be corrosion-proof in corrosive areas. Corrosive areas for this project are the filter rooms, chlorine storage, chlorination, fluoride, fluoride observation, and the aerator access rooms.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is a certified installer of the automatic control system/device manufacturer for both installation and maintenance of units/devices required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Product Data: Include manufacturer's technical literature for each control device required, labeled with setting or adjustable range of control. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Schematic flow diagrams showing fans, units, dampers, and control devices.

4. Wiring Diagrams: Power, signal, and control wiring.

5. Details of control panel faces, including controls, instruments, and labeling.

6. Schedule of dampers including size, leakage, and flow characteristics.

7. Field quality-control test reports.

8. Operation and maintenance data.

9. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

1.5 **COORDINATION**

A. Coordinate location of thermostats and other exposed control devices with plans and room details before installation.

B. Coordinate equipment with Division 26 to achieve compatibility with equipment that interfaces with that system.

C. Coordinate equipment with Division 26 to achieve compatibility with motor starters and annunciation devices.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. KMC.

2. Johnson Controls, Inc.; Controls Group.

3. Engineer approved equal

4. Schneider Electric by Wadsworth Solutions

2.2 **CONTROL PANELS**

A. Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels. For enclosure types and area classifications refer to Division 26. See paragraph 1.2-C-4 above also for corrosive and classified areas as panels to be properly constructed for the installed environment.

1. For non-corrosive/non-classified areas, fabricate panels of minimum 0.06-inch- thick, aluminum alloy, totally enclosed, with hinged and gasketed doors and keyed lock.

2. For corrosive/classified areas, fabricate panels of minimum 0.06-inch- thick, 304L or 316 stainless steel (not for any room with fluoride, use FRP), totally enclosed, with hinged

and gasketed/sealed doors and keyed lock. Panels to be constructed and rated for the intended installed location.

3. Panel-Mounted Equipment: Temperature controllers, relays, and automatic switches; except safety devices: Mount devices with adjustments accessible through front of panel.

4. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.

5. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.

6. All panels and components to be suitable for, and rated for, the installed location.

2.3 ANALOG CONTROLLERS

A. Electronic Controllers: Wheatstone-bridge-amplifier type, in properly rated enclosures with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

2.4 DDC CONTROLLERS

A. Approved DDC controllers may be used but must be 100% web accessible and 100% open BACnet, and all controllers used on the job must be the same manufacturer.

2.5 NOT USED

2.6 SENSORS

A. Electronic Sensors: Vibration and corrosion resistant; for wall, or duct mounting as required.

1. Thermistor temperature sensors as follows:

a. Accuracy: Plus or minus 0.5 deg F at calibration point.

b. Wire: Twisted, shielded-pair cable.

c. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.

d. Averaging Elements in Ducts: 36 inches long, flexible, use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.

e. Room Sensors: Match room thermostats, locking cover.

f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

2. Resistance Temperature Detectors: Platinum.

a. Accuracy: Plus or minus 0.2 percent at calibration point.

b. Wire: Twisted, shielded-pair cable.

c. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.

d. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.

e. Room Sensors: Match room thermostats, locking cover.

f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

B. Equipment operation sensors and other devices as follows:

1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 3 inches wg.

2. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current, comply with ISA 50.00.01.

3. Current Switches: Self-powered, solid state, with adjustable trip current, selected to match current and system output requirements.

C. Electronic Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

D. All components to be rated for the intended duty and installed location.

2.7 THERMOSTATS

A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.

B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.

C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.

1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.

2. Dead Band: Maximum 2 deg F.

D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in air ducts with flanges and shields.

2. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.

3. Scale settings and differential settings are clearly visible and adjustable from front of instrument.

4. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.

5. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

E. Low Voltage Thermostats: Commercial duty, electronic, with fan, heating, cooling, changeover, and switching and operation as required.

F. Room Thermostat Cover Construction: Manufacturer's standard locking covers.

G. Room thermostat accessories include the following:

1. Insulating Bases: For thermostats located on exterior walls.

H. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.

2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

I. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.

2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

J. All components to be rated for the intended duty and installed location.

2.8 **ACTUATORS**

A. Electric actuators: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Manufacturers:

a. By listed system manufacturers above or by Belimo Aircontrols (USA).

B. Responsibility – Damper operators shall be furnished and installed under this section of the specifications. Regardless of individual purchase agreements, the complete responsibility for installing, servicing, powering, adjusting, repairing, and replacing of the operators during the warranty period shall remain under this section.

C. Damper Operators – Shall be of the electric modulating or two-position style as required, direct coupled, type with a bracket arrangement located outside the air stream wherever possible. All damper operators shall be of sufficient size to operate their respective dampers effectively.

a. Where required the damper actuators shall be equipped with mechanical limit stops for minimum and maximum position requirements.

b. Provide integral end switches for monitoring actuator position and interlocking to motor starters.

D. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

2. Non-spring-Return Motors for Dampers Larger Than 25 Sq. Ft. : Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.

3. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. : Size for running and breakaway torque of 150 in. x lbf.

E. Electronic Damper Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Dampers: Size for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.

b. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.

c. Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft of damper.

d. Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.

e. Dampers with 2 to 3 Inches wg of Pressure Drop or Face Velocities of 1000 to 2500 FPM: Multiply the minimum full-stroke cycles above by 1.5.

2. Coupling: V-bolt and V-shaped, toothed cradle.

3. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

4. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.

5. Power Requirements (Two-Position Spring Return): 24-V ac.

6. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

8. Temperature Rating: Minus 22 to plus 122 deg F. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F. Run Time: 30 seconds.

F. All components to be rated for the intended duty and installed location.

2.9 CONTROL CABLE

A. Electronic Cable for Control Wiring: As specified in Division 26.

B. All cable and components to be rated for the intended duty and installed location.

2.10 AIRFLOW MEASURING EQUIPMENT AND COMPONENTS

A. Allowable Manufacturers: Air Monitor, Ebtron, Sage, or Engineer approved equal.

B. Industrial Duct Airflow Measuring Stations (AFMS's): Type 316 stainless steel (SS) with continuously welded casing seams, flanges (continuously fusion welded to casings), minimum 3 mill thick ½" or ¾" cell (3" deep, welded construction and mechanically fastened and rated to 4000 fpm and 600F), type 316 SS welded tubing total and static pressure headers with ¼" SS compression type connection fittings, and stainless steel engraved identification tags. Provide and install with transducers, ultra-low range differential pressure/flow transmitters (Class 1 Div. 2 rated for project classified locations and standard duty for project non-classified locations) with +/- 0.1% accuracy of natural span (including non-linearity, hysteresis, deadband, and non-repeatability), 0.5% of natural span (for 6 months) stability, auto-zero temperature effect correction, 0.5 second to reach 98% of a step change transducer response time, digital and analog inputs and outputs, low pass filtration, automatic zeroing, circuit protection, span and zero adjustments, minimum 5 line x 20 character backlit graphical LCD display, Modbus TCP/IP over Ethernet feature, and enclosure rated for installed location. AFMS's to be low voltage.

C. Provide all low voltage transformers/wiring required for work of this section.

D. All components to be rated for the intended duty and installed location.

2.11 MISCELLANEOUS COMPONENTS

A. All miscellaneous electrical components (switches, transformers, fuses, fuse blocks, pilot lights and sockets, etc.), shall be of a quality commercial grade and shall be manufactured by Honeywell, Eaton, Cutler Hammer, Square 'D', Potter-Brumfield, Allen Bradley or other approved.

B. Provide all properly rated and enclosed low voltage transformers required for work of this section as the E.C. is providing 120V circuits with J-boxes at various locations in all of the buildings for control use. Disconnects by temperature controls.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment level and plumb.

B. Verify location of thermostats, panels, and other exposed control sensors/devices with plans and room details before installation. Locate all 48 inches above the floor unless noted otherwise on plans.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

C. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

D. Install labels and nameplates to identify control components according to Division 23 Section 23 05 93, Testing, Adjusting and Balancing of HVAC Systems.

E. Install electronic cables according to Division 26.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26.

B. Install building wire and cable in conduit according to Division 26.

C. Install signal and communication cable according to Division 26.

1. Conceal conduit, except in mechanical rooms and areas where other conduit and piping are exposed.

2. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

3. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

3.3 CONNECTIONS

A. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

B. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

C. Ground equipment.

3.4 FIELD QUALITY CONTROL

A. **Manufacturer's Field Service**: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.

3. Calibration test controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Engage a factory-authorized service representative to perform startup service.

C. Replace damaged or malfunctioning controls and equipment.

D. Start, test, and adjust control systems.

1. Demonstrate compliance with requirements, including calibration and testing, and control sequences.

2. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

3.6 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project-site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

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SECTION 23 09 10

VARIABLE FREQUENCY DRIVES

PART 1-GENERAL

1.1 **SCOPE**

A. This specification describes the electrical, mechanical, environmental, agency and reliability requirements for three phase, adjustable frequency drives as specified herein and as shown on the contract drawings. Drives shall be furnished and mounted as shown on plans. Drives used throughout the project site shall be provided by the same manufacturer for all applications.

1.2 **REFERENCES**

A. The variable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of IEC, UL, CUL, NEC, IEEE, ANSI, and NEMA.

1.3 **SUBMITTALS - FOR REVIEW/APPROVAL**

A. The following information shall be submitted to the Architect.

1. Dimensioned outline drawing.
2. Schematic diagram.
3. Power and control connection diagrams.
4. Inverter efficiency and power factor curves.
5. Performance curves.
6. Sustentative data for Mean Time Between Failure (MTBF).

1.4 **QUALIFICATIONS**

A. The supplier of the assembly shall be the manufacturer of the electromechanical power components used within the assembly, such as bypass contactors when specified.

B. For the equipment specified each drive shall be UL listed.

C. Audible motor drive noise shall be within 5 db of across line noise operation.

1.5 **OPERATION AND MAINTENANCE MANUALS**

A. Operation and maintenance manuals shall include the following information:

1. Instruction books
2. Recommended renewal parts list.
3. Drawings and information required by section 1.3.

1.6 **WARRANTY**

A. All equipment shall be warranted for one year on all labor and materials.

B. **ALTERNATE:** The contractor shall provide an alternate cost for a five (5) year labor and material warranty of all equipment.

PART 2-PRODUCTS

2.1 **MANUFACTURERS**

A. Cutler-Hammer
B. Allen-Bradley
C. Toshiba
D. Eaton (Preferred manufacturer)
E. Reliance Electric
F. Danfoss
G. Square D

Naming specific venders does not imply acceptance of their standard products nor relieve them from meeting these specifications in their entirety.

2.2 **ELECTRONIC REQUIREMENTS**

A. Each drive shall be microprocessor based, fully transistorized with 3 phase, full wave diode bridge input, and pulse-width-modulating sine-coded output waveform.

B. Output transistors shall be of the Insulated Gate Bipolar Transistor (IGBT) type.

C. Minimum 20 years MTBF required.

D. Maximum switching frequency of 15 KHZ.

E. Displacement power factor shall be 0.98 or better over the entire operating frequency and load range.

2.3 **PROTECTIVE FEATURES**

A. Drive enclosures shall be NEMA 1 for normal indoor applications if located in conditioned electrical rooms, and shall be NEMA 4X for drives installed in any other areas and for drives installed for/inside HVAC units.

B. Controlled acceleration and deceleration shall be adjustable from 3 to 600 seconds. Current limits shall prevent overflow trips.

C. Minimum switching frequency shall be adjustable from 0 to 100 percent of base frequency.

D. Maximum switching frequency shall be adjustable from 110 to 0 percent of base frequency.

E. Automatic boost for 100 percent starting torque.

F. Hand-off-auto switch mounted in front door of mounting enclosure.

G. Fault contact for remote indication.

H. Contact closure for remote indication that drive is operating.

I. Automatic restart on fault that is programmable for 0 to 5 restarts.

J. Minimum of 2 critical frequency avoidance points with programmable deadband.

K. Output signal for motor speed shall be 0 to 10 vdc or 4-20 milliamp.

L. Output voltage regulation.

M. Continued operation of drive at 80 percent of last speed reference input if control command is lost.

2.4 OPERATION PROTECTION

A. Current limit control for protection against normal transients and surges from incoming power lines, grounding systems, or runaway incoming speed reference signal.

B. Protection from phase-to-phase and phase-to-ground faults.

C. Torque limit control.

D. Capabilities to start into a spinning load and wind-milling operation.

E. Instantaneous overcurrent trip to monitor peak currents and provide shutdown without component failure.

F. Input line reactors with a minimum of 3 percent rating on all incoming phase lines.

G. DC link choke to reduce current and voltage harmonics reflected to the AC power supply.

2.5 OPERATING CONDITIONS

A. Unit shall comply to the following operating conditions:
   1. Line voltage: +10 percent, -10 percent of rating.
   2. Line frequency: + or - 5 percent
   3. Overload: 100 percent
   4. Ambient temperature: 0 degrees to 40 degrees C.
   5. Altitude: 3,300 feet or less
   6. Atmosphere: 95 percent relative humidity, noncondensing
   7. Efficiency: 97 percent at 100 percent load, 100 percent base speed. 80 percent at 12.5 percent load, 80 percent speed.
   8. Fundamental power factor shall be 0.98 at all speeds and loads.

B. Digital operator/keypad is required and shall include the following features:
   1. Motor speed indication, in RPM, percent speed, or frequency (Hz)
   2. Speed reference signal

3. Alpha-numeric fault trip annunciation
4. Output current
5. Output power
6. Output voltage
7. Bus voltage

C. Indicator lights as follows:
1. Power on light
2. Run light
3. VFD trip light
4. External fault light.

D. The Mechanical Contractor shall require a sheave change so that the fan motor is producing its full rated horsepower at a VFD speed of 100%.

E. The variable speed fans shall be factory balanced throughout the entire range of operation.

2.6 OTHER FEATURES TO BE INCLUDED IN THE VFD'S

A. HMCP or thermal magnetic breaker to provide a disconnect means. Operating handle shall protrude from the door. The disconnect shall not be mounted on the door. The handle position shall indicate ON, OFF, and TRIPPED condition. The handle shall have provisions for padlocking in the OFF position with at least three (3) padlocks. Interlocks shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the ON position. This shall be defeatable by maintenance personnel.

B. Three contactor bypass shall include a drive input disconnect, a VFD input isolation contactor, bypass contactor and a VFD output contactor that is electrically and mechanically interlocked with the bypass contactor. This circuit shall include control logic, status lights and motor overcurrent relays. The complete bypass system (Inverter-Off-Bypass) selector switch, and inverter/bypass pilot lights shall be packaged with the VFD. The unit may be set up for manual bypass operation upon a VFD trip.

C. AC output contactor to provide a means for positive disconnection of the drive output from the motor terminals.

D. Laminated plastic or steel nameplate engraved with user's identifying name or number for oversize enclosures.

E. 120 Vac control to allow VFD to interface with remote dry contacts.

F. Motor overcurrent relay to provide motor overcurrent sensing of a given level of load current.

G. All three phase motors shall be protected with Phase Loss protection. Protection shall be provided by the electrical systems, built-in protection, or by protection built into a Variable Frequency Drive.

PART 3-EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.

2. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The Variable Frequency Drive shall trip electronically without device failure.

3. After all tests have been performed, each VFD shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.

4. After the burn-in cycle is complete, each VFD shall be put through a motor load test before inspection and shipping.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified manufacturer's employed Field Service Architect or authorized service representative to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of VFD's on the job site. Sales representatives will not be acceptable to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper VFD operation.

B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.

1. Inspection and final adjustments.

2. Operational and functional checks of VFDs and spare parts.

3. The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the VFD in accordance with those instructions.

C. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

3.3 WARRANTY/TRAINING

A. Manufacturer shall warrant complete drive system for a period of one (1) year.

B. A factory trained representative shall provide a minimum of 4 hours on-site training to owner selected personnel on the operation and maintenance of each drive installed. This training shall be videotaped, with two (2) copies provided to the owner.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope:**

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to provide the required sequences of operation.

B. **Coordination:**

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with or before controls or equipment relating to creating the required sequences of operation.

1.3 QUALITY ASSURANCE

A. **Requirements of Regulatory Agencies:** Comply with applicable provisions of regulatory agencies below and others having jurisdiction.

1. Local and State Building Codes and Ordinances. Ohio Building Code, Ohio Mechanical Code, and Ohio Fire Code.
2. National Fire Protection Association (NFPA), especially NFPA 820.
3. Underwriters' Laboratories, Incorporated (UL).
4. National Electric Code (NEC).
5. 10 States Standards.

B. **NEMA Compliance:** Motors and electrical accessories shall comply with NEMA standards.

C. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 SUBMITTALS

A. **Submit the following in accordance with conditions of contract and Division 1 specification sections and the additional requirements below.**

1. Submit sequences of operation along with the control shop drawings and product data.

1.5 CONTROL SEQUENCES

A. **MISCELLANEOUS EXHAUST FANS**: If not included/described below, refer to Fan Schedule on drawing H-15 for sequence of operation and/or method of control.

B. **ALL ELECTRIC UNIT HEATER'S (EUH'S):**

1. The unit heaters are furnished with electric heating coils and wall mounted thermostats (unless scheduled with integral stats). The thermostat shall cycle the fan and heating element as required to maintain setpoint of 60ºF (adjustable). When the thermostat setpoint is reached, the electric element shall de-energize and the fan shall continue to run to cool the electrical element, and, after the electric element has cooled, the fan shall stop.

C. **FILTER ROOM PERIMETER ELECTRIC HEATER'S:**

1. The heaters are to be controlled in banks (thru heater manufacturer supplied control panels) in response to wall mounted, low voltage, moisture-proof thermostats.

D. **GENERAL SPACE HEAT CONTROL VENTILATION SYSTEMS:** Associated exhaust fan (with motorized backdraft damper if so called out) is to be energized and the associated space intake damper is to open via a make-on-rise space stat. Stat and system operation to be multiple speed as required if called out/scheduled as such.

E. **GARAGE VENTILATION SYSTEMS:** See Fan Schedule.

F. **RTU SYSTEMS:** For RTU-1, 2, and 4, with these units being basically the same (constant volume, single stage DX cool, single stage gas heat, hot gas reheat for dehumidification, and with comparative enthalpy economizers with barometric relief sections), these units are to cool/heat/dehumidify and ventilate as required in response to a minimum 7-day programmable thermostat and a space (or duct if feasible) mounted humidity sensor. For RTU-3, operation is to be similar except that RTU-3 is to have a powered exhaust fan that is to work automatically to control zone pressure.

G. **CHLORINE STORAGE AND CHLORINATION ROOM ENTRY/EMERGENCY SWITCHES AND SPACE VENTILATION SYSTEMS:** Emergency (high-rate) ventilation operation pushbuttons (with fan on pilot lights) to be mounted outside and inside each chlorine room and they are to bring on the high rate ventilation when pressed. Refer to item G below for more information.

H. **HV-2 SYSTEM SERVING CHLORINE ROOMS (AND INCLUDING EF-7, 7A, 8, and 8A) AND MOTORIZED HIGH RATE AIR INTAKES FOR THE ROOMS:** Constant volume HV-2 with modulating electric heat is to run continuously (along with EF-7A and EF-8), and this is to provide space ventilation at 12 air changes (AC's) per hour. The heat within HV-2 is to be controlled via discharge air temperature, but is to also have room override. Unit/system control to be accomplished via HV unit manufacturer supplied controls and contractor supplied controls, coordinate same. Upon a trip of a space mounted process related chlorine detector, or by trip of the indoor or outdoor ventilation start switches/buttons, HV-2 and EF-7A and EF-8 are to remain on, the motorized wall air intakes into both chlorine rooms are to open

(and are to be proven open), and EF-7 and EF-8A are to come on for high rate ventilation (60 AC's/hr.). Whenever EF-7 or 8A run, this operation is to be alarmed.

I. **HV-4 SYSTEM SERVING FLUORIDE ROOM AND FLUORIDE OBSERVATION ROOM, ALONG WITH EF-9:** HV-4 to run continuously (along with EF-9) to constantly ventilate the Fluoride Room and the Fluoride Observation Room. The HV-4 electric heating section is to be modulated to maintain the HV-4 discharge duct setpoint but with room override. Unit/system control to be accomplished via HV unit manufacturer supplied controls and contractor supplied controls, coordinate same. The pressure control damper PCD-1 in the wall between Fluoride and Fluoride Observation is to be controlled via differential pressure to make sure Observation is always positive with respect to Fluoride. Refer to drawings and other specification sections for additional information.

J. **HV-5 SYSTEM SERVING THE FILTER ROOMS, ALONG WITH FANS EF-11, 12, 16, AND 17:** HV-5 (constant volume with modulating electric heat) is to run, along with exhaust fans EF-11, 12, 16, and 17, when manually initiated by the plant operator as needed via a remote operating station. HV-5 heating section to be controlled via discharge air temperature, but is to have room temp override. Unit/system control to be accomplished via HV unit manufacturer supplied controls and contractor supplied controls, coordinate same.

K. **GENERATOR INTAKE DAMPERS**: To operate same as existing.

L. **PIPE GALLERY DEHUMIDIFICATION SYSTEM (BASICALLY CONSISTING OF CONSTANT VOLUME DEHUMIDIFIER DH-1 AND ASSOCIATED AIR COOLED CHILLER CH-1):** With DH-1 having a desiccant dehumidification wheel with face-and-bypass, a process side fan, a process side chilled water post cooling coil, an electric reactivation heat section, and a reactivation side fan, the unit is to run continuously to maintain the required conditions setpoints in the gallery and to make sure no condensation forms in the gallery. Unit wheel operation, post cooling, and reactivation functions are to happen automatically, as is chiller CH-1 operation as chilled water is needed. See schedules and drawings and other specification sections for additional information.

M. **HSPR HEAT CONTROL VENTILATION (BASICALLY CONSISTING OF 3-STAGE VARIABLE AIR VOLUME HV-1 (UNHEATED) AND (6) EXISTING HIGH WALL EXHAUST FANS):** Heat control ventilation to be staged (3 stages) with the existing (6) wall exhaust fans ((2) fans on per stage) via (1) space mounted, proportional, make-on-rise temperature sensor to control room heat.

N. **WELL BUILDING HEATING AND VENTILATING SYSTEMS:** See schedules, and drawing H-4.

O. **ACTION REQUIRED FROM SYSTEM DUCT SMOKE DETECTOR TRIP:** Upon trip of any system duct smoke detector, associated air moving unit/device is to stop (along with any other interlocked or associated unit/device that if left running would cause a hazard or damage), and trip is to alarm.

P. **ALARMS TO BE TIED INTO BUILDING SCADA SYSTEM (SCADA SYSTEM CAN RECEIVE GENERAL ALARMS IN THE FORM OF DRY**

CONTACTS):

1. Any duct smoke detector trip or trouble.
2. Any HV unit trouble.
3. Any EF trouble/status issues.
4. Fluoride Observation Room not being positive wrt to Fluoride.
5. High rate chlorine area high ventilation rate trip, ventilation operation, or trouble/status issue.
6. Any temperatures or humidities being out of range.
7. Electric room temperature being out of range.
8. Any DH-1 or CH-1 trouble or status issue.
9. Any RTU trouble or status issue.
10. Glycol injection package GMP trouble.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

A. The installation shall include drawings, supervision, adjusting, and validating check-out necessary for an operational systems, maintenance and instructions.

B. Provide diagrams for wiring pertinent to temperature control system operation.

C. This contractor shall be responsible for the installation of all equipment required to furnish an operating system of HVAC system control. He shall supervise the work of the electrical contractor as it affects his work.

D. This control installation shall be made by competent qualified mechanics.

E. All controls and components shall be tagged by location and function. Each control component in the control cabinet shall be marked under the component. Do not mark faces of components.

END OF SECTION

SECTION 23 21 13

HVAC PIPING

PART 1-GENERAL

1.1 SECTION INCLUDES

A. HVAC piping.

1.2 SUBMITTALS

A. Submit shop drawings and product data per applicable Division I Specification.

B. Shop drawings shall include product data noting materials, sizes, and dimensions.

1.3 QUALITY ASSURANCE

A. Follow manufacturers requirements for installation.

B. Welding procedures per ANSI/ASME Section 9, AWS D10.9 and D1.1 and the National Certified Pipe Welding Bureau.

C. Brazing procedures per ANSI B31.5 and the ASME Boiler and Pressure Vessel Code SFA-5.8, Section II.

D. Soldering procedures per ANSI B16.18.

E. Comply with ANSI B31 pressure code for pressure piping.

PART 2-PRODUCTS

2.1 HVAC PIPING

A. Chilled Glycol/Water Supply and Return Piping, and Glycol Injection Piping.

1. Copper piping

a. Piping 2-1/2 inches and smaller shall be type L copper per ASTM B88 with soldered joints. Fittings shall be wrought copper per ANSI B16.22.

2. Copper press fittings may be used as an option per ASTM B16.18 or ASTM B16.22. O-rings shall be EPDM.

B. Air Conditioning Condensate/Drain Piping

1. Piping shall be type L copper per ASTM B88 with soldered joints. Fittings shall be wrought copper per ANSI B16.22

PART 3-EXECUTION

3.1 INSTALLATION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Provide pipe hangers and supports in accordance with Section 23 05 29 unless indicated otherwise.

E. Use ball or butterfly valves with memory stop for shut off and to isolate equipment, part of systems, or vertical risers.

F. Use ball or butterfly valves with memory stop for throttling, bypass, or manual flow control services.

G. Use lug end butterfly valves in hydronic systems for all piping 2- 1/2" and larger. Use ball valves in hydronic systems for all piping 2" and under.

H. Use 3/4 inch ball valves with hose end and cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

I. Not used.

J. Install in accordance with manufacturer's instructions.

K. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

L. Route piping in orderly manner and maintain gradient.

M. Install piping to conserve building space and not interfere with use of space and other work.

N. Group piping whenever practical at common elevations.

O. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

P. Provide clearance for installation of insulation and access to valves and fittings.

Q. Provide sleeves when penetrating footings, floors and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

R. Install valves with stems upright or horizontal, not inverted.

END OF SECTION

SECTION 23 31 13

METAL DUCTWORK AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install complete duct systems with all appurtenances.

B. Coordination:
   2. Review installation procedures under other Sections and coordinate the installation of items that must be installed with or before the duct system.

1.3 QUALITY ASSURANCE

A. Reference Standards: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
   2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
      a. Low Pressure Duct Construction Standards, and SMACNA Industrial Duct Construction Standards (as applicable on project).
   3. National Fire Protection Association (NFPA).
      a. NFPA 90A – Standard for the installation of air conditioning and ventilating systems.

B. Fabricator's Qualifications: Fabricator shall have a minimum of 5 years of experience in producing substantially similar duct systems and equipment and shall show evidence of at least 5 installations in satisfactory operation.

C. Requirements of Regulatory Agencies: Comply with the applicable provisions of regulatory agencies below and others having jurisdiction.
   4. Local and State Building Codes and Ordinances.
      a. Ohio Building Code.
      b. Ohio Mechanical Code.
   5. Underwriters' Laboratories, Incorporated.

6. National Fire Protection Association.

D. Field Measurements: Take field measurements where required prior to installation to ensure proper fitting of work.

E. The CONTRACTOR must comply with the enclosed specification in its entirety. If on inspections, the ENGINEER finds changes have been made without prior written approval, the CONTRACTOR will make the applicable changes to comply with this specification, at the CONTRACTOR'S expense.

F. At the discretion of the ENGINEER, sheet metal gauges, and reinforcing may be checked at various times to verify all duct construction is in compliance.

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:
   1. Manufacturer's literature, illustrations, specifications, and engineering data.
   2. Drawings showing fabrication methods, assembly, installation details and accessories to include the following:
      a. 1/4-inch scale duct layouts.
      b. Dimensions.
      c. Details and materials of construction.
      d. Details of installation.
      e. Manufacturer's literature, illustrations, specifications and engineering data.
      f. Registers, grilles and diffusers.
      g. Access doors.
      h. Flexible connections.
      i. Other material and equipment requested by ENGINEER.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections and Supplementary Requirements below.

B. Storage of Materials:
   1. Store equipment and materials so as to keep free from moisture, damage, and deterioration.

C. Handling of Materials:
   2. All material labels or tags will be intact and legible.

1.6 JOB CONDITIONS

A. Sequencing: Obtain ENGINEER'S approval of Shop Drawings before fabricating and installing ductwork and accessories.

1.7 GENERAL REQUIREMENTS

A. Construct rectangular metallic ductwork to meet all functional criteria defined in Section VII of the current SMACNA – "HVAC Duct Construction Standards Metal and Flexible" edition. No other criteria pertaining to rectangular duct construction will be accepted. Furthermore, all ductwork must also comply with all applicable local, state and federal code requirements.

PART 2 PRODUCTS

2.1 DUCTWORK

A. Sheet Metal Materials
   1. Aluminum Duct: ASTM B209 (ASTM B209M), Alloy 3003, Temper H14, sheet form with standard one-side bright finish for ducts exposed to view and with mill finish for concealed ducts.
   2. Stainless Steel Sheets: Comply with ASTM A 480, Type 304L, cold rolled, annealed, sheet, as indicated in 2.9 herein. Exposed surface finish to be No 2B.
   3. Reinforcement Shapes and Plates: Aluminum reinforcement where installed on aluminum sheet metal ducts; Type 304 stainless for stainless ducts.

2.2 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
   1. Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 per-cent solids.
   2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, use O.

2.3 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. See "Static-Pressure Classes" and "Leakage and Seal Classes" articles in 2.4 below for discussion on fabrication.

B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated. This includes the SMACNA adjusted requirements for aluminum ducting using SMACNA's "Conversion of Steel Tables to Aluminum" and the associated text based requirements.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing

requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", but adjust per SMACNA for aluminum or stainless steel ducts.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", but adjust per SMACNA for aluminum or stainless steel ducts. All longitudinal seams Pittsburgh Lock.

E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", and in coordination with details on the drawings, but adjust per SMACNA for aluminum or stainless steel ducts..

2.4 METAL RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards—Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discoloration.

B. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:

3. Outdoor Ducts: 3-inch wg.
4. Indoor Ducts: 2-inch wg.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, but adjust per SMACNA for aluminum or stainless steel ducts.

D. Steel and Aluminum Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams. Snaplock is not acceptable.

E. Ductwork Leakage Criteria.

5. All ductwork to be sealed to SMACNA Seal Class A sealing requirements.
6. Constant Volume Systems/Supply Ductwork Allowable Leakage—1% of design cfm.
7. Constant Volume Systems/Return/Exhaust Ductwork Allowable Leakage - 1% of design cfm.

2.5 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated, but adjust per SMACNA for aluminum or stainless steel ducts..

1. Manufacturers:
   a. McGill AirFlow LLC.
   b. SEMCO Incorporated.
   c. Spiral Manufacturing Co., Inc.
   d. Or approved equal.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
4. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.6 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, self-drill fasteners, or structural-steel fasteners appropriate for building materials.

B. Hanger Materials for Stainless and Aluminum Ducts: Type 304 stainless.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; 304 stainless steel.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Stainless Steel and Aluminum Ducts: Type 304 stainless steel.

2.7 ACCESSORIES

A. Turning Vanes
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ductmate Industries, Inc.
      b. METALAIRE, Inc.
      c. SEMCO Incorporated.
      d. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
      e. Or approved equal.
   2. Manufactured Turning Vanes for Aluminum Ducts: Fabricate curved blades of aluminum to match surrounding duct materials, at gages required for stability and strength, set into vane runners, suitable for duct mounting.
   3. Manufactured Turning Vanes for Stainless Steel Ducts: Curved blades of 304 stainless sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   4. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows Flexible", but adjust per SMACNA for aluminum or stainless steel ducts."
   5. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

B. Flange Connectors
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ductmate Industries, Inc.
      b. Nexus PDQ; Division of Shilco Holdings Inc.
      c. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
      d. Or approved equal.
   2. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
   3. Materials: Match connecting ductwork.

C. Volume Dampers:
   1. Provide products by one of the following:
      a. Air Balance Inc.; a division of Mestek, Inc.
      b. American Warming and Ventilating; a division of Mestek, Inc.
      c. Ruskin Company.
      d. Or approved equal.
   2. Rectangular dampers shall be multiple opposed blade type with channel frame, exterior linkage and position indicator and locking device. Blades shall not exceed 6-inch in width.
   3. Round dampers shall be shop fabricated, single blade type with position indicators and locking device. For sheet metal systems, ma-

terial shall be two gauges heavier than ductwork or 18 gauge, whichever is heavier.

4. Dampers shall be constructed of the same material as the ductwork and shall be suitable for horizontal or vertical applications.
5. Balancing and balancing/shut off dampers shall be opposed blade. Shut off dampers shall be parallel blade.
6. All dampers shall be selected for a rating that equals or exceeds the specified system pressure and velocity.
7. Dampers shall be supplied with locking quadrants.
8. Damper Hardware for Aluminum Ducts: Same materials as ductwork, with gages and construction techniques to provide adequate strength and proper operation. Include elevated platform for insulated duct mounting.
9. Damper Hardware for Stainless Ducts: Type 304 stainless steel with dial and handle made of minimum 3/32-inch- thick stainless steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
10. Shut off dampers shall have replaceable neoprene blade seals. Leakage rate shall not exceed 7 cfm/sq. ft. at 4-inch wg for rectangular dampers and 0.15 cfm/in of perimeter at 4-inch wg for round dampers.

D. Duct Mounted Access Doors

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Warming and Ventilating; a division of Mestek, Inc.
   b. Ductmate Industries, Inc.
   c. Flexmaster U.S.A., Inc.
   d. Or approved equal.
2. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
   a. Door:
      1.) Double wall, rectangular.
      2.) Galvanized or aluminum or stainless sheet metal (to match duct) with insulation fill and thickness as indicated for duct pressure class.
      3.) Vision panel.
      4.) Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
      5.) Fabricate doors airtight and suitable for duct pressure class.
   b. Frame: Aluminum or 304 stainless sheet (to match duct), with bend-over tabs and foam gaskets.
   c. Number of Hinges and Locks:

1.) Access Doors Less Than 12 Inches Square: No hinges and at least two sash locks.
2.) Access Doors up to 18 Inches Square: Minimum two hinges or continuous and at least two sash locks.
3.) Access Doors up to 24 by 48 Inches: Minimum three hinges and at least two compression latches with outside and inside handles.
4.) Access Doors Larger Than 24 by 48 Inches: Minimum four hinges and at least two compression latches with outside and inside handles.

E. Rectangular Flexible Connectors
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Ductmate Industries, Inc.
b. Ventfabrics, Inc.
c. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
d. Or approved equal.
2. Materials: Flame-retardant or noncombustible fabrics.
3. Coatings and Adhesives: Comply with UL 181, Class 1.
4. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of minimum 2-3/4-inch wide, minimum 0.032-inch- thick aluminum sheets or 304 stainless steel (to match ducts).
5. Connector fabric in "Indoor System, Flexible Connector Fabric" Paragraph below is not suitable for exposure to sun, weather, or corrosive environments. It is suitable for system temperatures from minus 10 to plus 200 deg F.
6. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
a. Minimum Weight: 26 oz./sq. yd.
b. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
c. Service Temperature: Minus 40 to plus 200 deg F.
7. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
a. Minimum Weight: 24 oz./sq. yd.
b. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
c. Service Temperature: Minus 50 to plus 250 deg F.

F. Backdraft Dampers
1. Manufacturers:
a. Air Balance Inc.; a division of Mestek, Inc.
b. Ruskin Company.
c. SEMCO Incorporated.
d. Or approved equal.

2. Description: Gravity balanced.
3. Maximum Air Velocity: 3000 fpm
4. Maximum System Pressure: 3-inch wg.
5. Frame: 0.063-inch thick extruded aluminum with welded corners and mounting flange.
6. Blades: Multiple single-piece blades, center-pivoted, 0.050-inch thick aluminum sheet with sealed edges.
7. Blade Action: Parallel.
8. Blade Seals: Neoprene, mechanically locked.
9. Tie Bars and Brackets: Aluminum.
10. Return Spring: Adjustable tension.
11. Adjustment device to permit setting for varying differential static pressure.
12. Counterweights and spring-assist kits for vertical airflow installations.
13. Screen Mounting: Rear mounted.
14. Screen Material: Aluminum.
15. Screen Type: Bird.
16. 90-degree stops.
17. If ducts stainless, dampers and all hardware to be 304 stainless.

G. Control Dampers
1. Manufacturers:
   a. Ruskin Company.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. McGill AirFlow LLC.
   d. Or approved equal.
2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Frames:
   a. Mitered and welded corners.
4. Blades:
   a. Multiple blade with maximum blade width of 8 inches.
   b. Opposed blade design.
   c. Galvanized steel, 0.064 inch thick.
   d. Blade Edging: Closed-cell neoprene edging.
   e. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
   f. If in aluminum ducts, fabricate per SMACNA/AMCA out of aluminum to match surrounding duct.
5. Bearings:
   a. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   b. Thrust bearings at each end of every blade.
6. If ducts stainless, dampers to be 304 stainless.

H. Duct Accessory Hardware
   1. Instrument Test Holes: Cast aluminum or stainless to best suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
   2. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.8 REGISTERS, GRILLES AND DIFFUSERS

A. All diffusers, registers and grilles shall be of the shape, sizes, capacity and type as shown on the drawings.

B. Manufacturer: Provide product by one of the following:
   1. Titus.
   2. Metalaire.
   3. Anemostat.
   4. Greenheck.

C. Supply Air Registers:
   1. Shall be minimum ¾-inch spacing (but refer to schedule for any differences required), double deflection types with opposed blade aluminum dampers, with front and rear blade orientations chosen for best performance, and with grille and damper of painted aluminum per scheduled model.

D. Exhaust Air Registers:
   1. Shall be ¾-inch spacing (but refer to schedule for any differences required), louvered aluminum fixed blade type with opposed blade aluminum dampers, and with grille and damper of painted aluminum.

E. Eggcrate Type Return/Exhaust Air Grilles:
   1. Shall be ½" square style of painted aluminum (but refer to schedule for any differences required).

2.10 DUCT MATERIAL APPLICATION

A. All ductwork/systems/accessories/specialties that need to be aluminum or stainless steel will be called out on the drawings, see same.

PART 3 EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the

proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 DUCT INSTALLATION

A. All ductwork shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished; ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.

B. Construct and install each duct system for the specific duct pressure classification indicated.

C. Install ducts with fewest possible joints.

D. Seal all ducts to Seal Class A as per SMACNA Standards. Seal externally insulated ducts before installing insulation.

E. Elbows shall have a minimum centerline radius of 1-1/2 times the width of the duct. Turning vanes shall be provided at all square elbows. Turning vanes shall be quiet and free from vibration when the system is in operation.

F. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with required clearances plus allowances for insulation thickness.

I. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.

J. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials.

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete. Inserts must be corrosion resistant.
2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection, but adjust as required per SMACNA for aluminum and stainless steel ducts.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 FITTING AND ACCESSORY INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts, in accordance with SMACNA “Industrial Duct Construction Standards” (if applicable on job), and in accordance with accessory manufacturer’s instructions.

B. Install duct accessories of materials suited to duct materials; use stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

D. Install couplings tight to duct wall surface with a minimum of projections into duct.

E. Elbows shall have a minimum centerline radius of 1-1/2 times the width of the duct. Turning vanes shall be provided at all square elbows. Turning vanes shall be quiet and free from vibration when the system is in operation.

F. Provide flexible connections at inlet and discharge of air handling equipment.

G. Provide manual splitter dampers and volume dampers where indicated on the Drawings and as required to facilitate accurate volume control.

H. Provide gasketed access doors in ductwork for all dampers and louvers for inspection and maintenance.

I. Air volume extractors shall be provided at supply registers for scooping or extracting air into the outlet. The extractors shall have fully adjustable, gang operated curved blades controlled through an external manual adjustable device.

J. Install backdraft dampers at outlets of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

K. Install volume dampers at points on make-up air, supply, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

L. Set dampers to fully open position before testing, adjusting, and balancing.

M. Install test holes at fan inlets and outlets and elsewhere as indicated.

N. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. At outdoor-air intakes and mixed-air plenums.
   2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   3. At each change in direction.
   4. At each smoke damper and at each airflow measuring station.
   5. Upstream or downstream from turning vanes.
   6. Control devices requiring inspection.

O. Install access doors with swing against duct static pressure.

P. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

Q. Label access doors according to Division 23 Section "HVAC and Plumbing Identification" to indicate the purpose of access door.

R. Install duct test holes where required for testing and balancing purposes.

3.6 STARTUP AND COMMISSIONING

A. Comply with Division 1 Sections and Section 23 05 93, Testing, Adjusting and Balancing of HVAC Systems.

B. Set volume control devices for approximate positions in preparation for final testing and balancing.

C. Start fan system and check for excessive leaks and vibration and correct.

D. Remake leaking joints and retest until leakage is less than maximum allowable.

E. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

F. Adjust volume-control dampers in ducts, outlets and inlets to achieve design air flow.

3.7 DUCT CLEANING

A. Comply with Division 1 Section "Cleaning".

B. Remove all loose materials and obstructions from interior of ducts.

C. Remove debris and waste materials resulting from installation.

END OF SECTION

SECTION 23 31 14

FRP DUCTWORK AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install complete duct systems with all appurtenances.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with or before the duct system.

1.3 QUALITY ASSURANCE

A. Reference Standards: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
   2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
      a. Thermoset FRP Duct Construction Manual.
   3. ASME RTP-1.
   4. National Fire Protection Association (NFPA).
      a. NFPA 90A – Standard for the installation of air conditioning and ventilating systems.

B. Fabricator's Qualifications: Fabricator shall have a minimum of 5 years of experience in producing substantially similar duct systems and equipment and shall show evidence of at least 5 installations in satisfactory operation.

C. Requirements of Regulatory Agencies: Comply with the applicable provisions of regulatory agencies below and others having jurisdiction.
   1. Local and State Building Codes and Ordinances.
      a. Ohio Building Code.
      b. Ohio Mechanical Code.
   2. Underwriters' Laboratories, Incorporated.
   3. National Fire Protection Association.

D. Field Measurements: Take field measurements where required prior to installation to ensure proper fitting of work.

E. The CONTRACTOR must comply with the enclosed specification in its entirety. If on inspections, the ENGINEER finds changes have been made without prior written approval, the CONTRACTOR will make the applicable changes to comply with this specification, at the CONTRACTOR'S expense.

F. At the discretion of the ENGINEER, material thicknesses and reinforcing may be checked at various times to verify all duct construction is in compliance.

G. Manufacturer shall provide the following information with the pre-approval package:
1. (2) sample cutouts demonstrating 100 to 110 mil clear liner with no antimony and filament wound structural laminate. Samples to be a minimum of 8" diameter cut-out and a 12" diameter piece of duct at least 12" long complying with RTP-1 visual level II.
2. Company filament winding history and at least two (2) FRP duct job names with similar type construction, including contact names and phone numbers.
3. (2) copies of the fabricators ISO 9000 based Quality Control Manual or equal.
4. A letter from an outside testing agency confirming RTP-1 visual level II quality and the quantity and the size of the specimens examined.
5. Certified testing data from an outside testing agency confirming the resin and glass contents of the liner and structural layers separately.
6. Any fabricator unable to provide this information and samples to the engineer 48 hours prior to bid date will not be considered.

H. All FRP ductwork shall be fabricated and installed by qualified, experienced mechanics who have a minimum of 5 years experience with the lay-up, fabrication and joining of this type of material.

I. Factory Inspection:
1. Owner shall be given access to the FRP ductwork and all quality control records during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents.
2. The owner shall maintain the right to tour the FRP duct manufacturer's plant anytime that fabrication is in process prior to final shipment. The owner and engineer may exercise the option, without any advance notice, to tour the plant and inspect all stages of fabrication to ensure that quality control is being maintained.
3. Inspection by owner does not relieve any responsibility of the fabricator to meet the requirements of this specification.

J. Acceptance:
1. Lack of compliance with any aspect of the specifications and drawings will be grounds for rejection of the ductwork.
2. Repair of rejected ductwork - repair procedures must be approved by the owner prior to implementation. No more than 5% of the surface area of each FRP duct component may be repaired.

K. The fabricators inspector (Quality Control Manager) will provide the owner with a complete Quality Control report for the job. The report will be available within 15 days after the final parts are shipped. The fabricator will have available after each shipment the complete QC sheets for review upon request at any time.

1.4 **SUBMITTALS**

A. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Manufacturer's literature, illustrations, specifications, and engineering data.
2. Drawings showing fabrication methods, assembly, installation details and accessories to include the following:
    a. 1/4-inch scale duct layouts.
    b. Dimensions.
    c. Details and materials of construction.
    d. Details of installation.
    e. Manufacturer's literature, illustrations, specifications and engineering data.
    f. Register and grille take-offs.
    g. Access Doors/cleanout fittings/connections.
    h. Flexible connections and expansion joints.
    i. Duct buoyancy data and buoyancy force offset fittings/attachments.
    j. Other material and equipment requested by ENGINEER.

1.6 **Submittals (Additional)**

A. Provide the following information in addition to the standard submittal requirements with the Bid:

1. The fabricator shall submit for approval all reference standards, calculations, fabrication drawings and all engineering details of the duct design prior to the beginning of fabrication.
    a. The submittal should include all information utilized by the fabricator which describes specifically how their FRP duct is manufactured. This should be in the form of shop drawings, standards, specifications, other instructions QC records. This should include, but not be limited to:
        1. Resin type
        2. Types and amounts of filler
        3. Corrosion liner description
        4. Reinforcement types for hand lay-up or chopped laminates
    b. For filament-wound laminates
        1. Helix angle
        2. Glass content range
        3. Strand yield
        4. Strands per inch in the winding band
        5. Ply thickness
        6. Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate
    c. For all fabricated parts
        1. Construction type
        2. Laminate thickness
        3. Ply sequences
        4. Glass content range
    d. For all secondary overlays (both interior and exterior)
        1. Laminate thickness
        2. Ply sequences and widths
    e. Construction details for all other special configurations and fabricated parts

2. FRP duct cutout a minimum of 8” diameter and of the quality of workmanship and glass / resin being quoted. These will be retained for quality comparison on materials shipped to jobsite.

3. Recommended procedure for the protection and handling of materials prior to installation.
4. ISO 9000 based Quality Control System, or approved equal, detailing shop QC inspection procedures and documentation and samples of all shop QC forms utilized in the process.

1.7 **PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections and Supplementary Requirements below.

B. Storage of Materials:

1. Store equipment and materials so as to keep free from moisture, damage, and deterioration (including from UV exposure).

C. Handling of Materials:

1. All material labels or tags will be intact and legible.

1.8 **JOB CONDITIONS**

A. Sequencing: Obtain ENGINEER'S approval of Shop Drawings before fabricating and installing ductwork and accessories.

1.9 **GENERAL REQUIREMENTS**

A. Construct rectangular ductwork to meet all functional criteria defined in the current SMACNA – "Thermoset FRP Duct Construction Manual" edition. Furthermore, all ductwork must also comply with all applicable local, state and federal code requirements.

PART 2 PRODUCTS

2.1 **GENERAL**

A. Fiberglass Reinforced Plastic Duct as manufactured by Spunstrand® Inc. or approved equal shall be used to convey and distribute air as shown on the drawings.

2.2 **MATERIALS**

A. FRP Duct:

1. Type: Filament wound rated at design pressures indicated in the drawings. Minimum wall thickness shall be .125" for sizes 2" thru 22", .187" for sizes 24" thru 36", and .250" for sizes 42" thru 60". Rectangular ductwork thickness shall be determined by substituting the long side dimension for the round equivalent diameter thickness, and 1/16 inch greater.
2. Grade: Type 1, Grade 2 RTRP vinylester, Class E per ASTM D-2310.
3. All duct shall be designed for not less than 20 inches water column pressure and 12 inches water column vacuum.
4. A minimum structural safety factor of 5 to 1 shall be used in the design of ducting.
5. Maximum deflection of rectangular ducts under deadload and operating conditions shall not exceed 1% of the width of the longest side.
6. The Type A resin used shall be Hetron 992SB, AOC KO22, Corezyn Corve8440 or Derakane 510 resin, depending on availability, selected as best to meet the

project exposures and temperatures of the air to be exhausted. Fillers, other than those added for flame retardance when required, shall **not** be allowed, and should not exceed 5% by weight. Flame spread rating shall be 25 or less per ASTM E-84.

7. Corrosions Liner: Inner surface shall contain a 20 mil thick minimum surface veil saturated with vinylester resin consisting of approximately 90% resin and 10% glass content by weight. The surface veil shall be overlapped a minimum of 1".
8. Structural layer shall be filament wound of Type A premium grade vinylester resin and glass as required for the specific working pressure, bedding conditions, and design conditions.
9. Exterior of pipe/duct shall contain sufficient resin to ensure a relatively smooth surface free from exposed glass fibers or sharp projections and shall contain an ultra violet inhibiting agent.
10. Standard lengths shall be in accordance with the manufacturers published product data sheets. Wall thickness of the duct furnished shall not at any joint be less than 87.5% of the nominal wall thickness specified when measured in accordance with ASTM D-3567 Standard Method of Determining Dimensions of Reinforced Thermosetting Resin Pipe and Fittings.
11. Duct Stiffness: The duct shall have sufficient strength to exhibit, without structural damage, a minimum rated stiffness in accordance with ASTM D-2412 for the pipe laying conditions as noted for the design conditions.
12. Duct manufactured with a composite structural wall containing sand, alumina or other granular fillers is **not** acceptable.
13. Any outdoor duct exposed to sunlight to have UV resistant finish/coating.

2.3 **ACCESSORIES**

A. Fittings/Take-offs:

1. Construction shall be as specified for the ducting.
2. Bends shall be formed over a removable mold up thru 30" diameter and fabricated from straight duct for larger sizes with the following miter segments:
    a. Bends up to 30° - 1 miter / 2 gore
    b. 31° to 60° bend - 2 miter / 3 gore
    c. 61° to 90° bend - 4 miter / 5 gore
3. Corrosion resistance and working pressure equal to that of connecting duct.
4. All take-offs to be expanded or conical type, no straight taps.

B. Duct Joints: Same material as the duct and shall meet or exceed the hoop tensile strength and axial strength requirements of the duct. Duct joints to also to be constructed to withstand the project buoyancy requirements.

1. Joints:
    a. Duct joints shall be butt and wrap.
    b. Fittings shall be plain end for butt and wrap.
    c. Adhesive material for field joints shall be suitable for minimum 250° F continuous service.
2. Flanges:
    a. Flanges shall be hand lay-up per NBS PS 15-69 and furnished undrilled.
    b. Flange gasket shall be suitable for 250° F continuous service and constructed of neoprene rubber or approved equal.

C. Supports and Hangers:

1. FRP ductwork shall be supported at intervals no greater than 10-foot centers. Supports and hangers shall transmit all ductwork load into the building structural frame through a system of intermediate beams and struts as nec-

essary to accommodate requirements of these specifications.

D. Dampers (Non-Smoke):

1. FRP dampers shall be fabricated with the same materials as the duct. No resin variations will be acceptable. Blade shall be FRP 2 piece molded including blade stiffeners per schedule on drawing. Damper blade shall be offset 5° in closed position to form a normal stop on wall of duct. Axle to be pultruded FRP made with same resin and continuous strand roving. Bearings to be Teflon. O-rings shall be Viton. No metal parts or cut edges in airstream will be allowed.
2. Volume dampers to be manually operated Spunstrand® Inc. single blade, plain end by plain end volume dampers.
3. Balancing dampers to be Spunstrand® Inc. BA series, or Swartwout model 912 with blade shop, axle shaft seals and locking hand quadrant.
4. Isolation dampers to be Spunstrand® Inc. ZL Series (Zero Leak), Ershigs type "B", or Swartwout model 914 with blade seals, axle shaft seals, and gear operator. Flanges included on all isolation dampers and on balancing dampers when shown on drawings. Either damper submitted shall have AMCA certified leakage rates or shall be individually water tested and certified leak free. No other shop-fabricated dampers shall be allowed. See separate specifications for Zero Leak Dampers and cut-sheets.
5. Rectangular Dampers:
   a. Rectangular multi-blade volume dampers to be single blade manual dampers manufactured by Spunstrand Inc.
   b. Rectangular multi-blade dampers shall be Swartwout 426AF with airfoil blade seals, rated with certified AMCA leakage rates and shall not exceed 20 cfm per sq./ft.

E. Take-Offs for Grilles/Registers:

a. Rectangular take-offs to be FRP to match main ducts, and are to have flanges for mounting of registers/grilles.

PART 3 EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 DUCT INSTALLATION

A. All ductwork shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished; ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.

B. Construct and install each duct system for the specific duct pressure classification indicated and to withstand the project buoyancy requirements.

C. Install ducts with fewest possible joints.

D. Seal all ducts to Seal Class A as per SMACNA Standards. Seal externally insulated ducts before installing insulation.

E. Elbows shall have a minimum centerline radius of 1-1/2 times the width of the duct. Turning vanes shall be provided at all square elbows. Turning vanes shall be quiet and free from vibration when the system is in operation.

F. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with required clearances plus allowances for insulation thickness.

I. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with stainless steel or FRP flanges. Overlap opening on four sides by at least 1-1/2 inches.

J. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials.

K. Provide dampers as required for system balancing.

3.3 **INSTALLATION OF EXPOSED DUCTWORK**

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with duct/flanges. Create a smooth and uniform exposed bead.

C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and other fittings.

D. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 **HANGER AND SUPPORT INSTALLATION**

A. Comply with SMACNA's "Thermoset FRP Duct Construction Manual" and with duct manufacturer’s requirements.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's " Thermoset FRP Duct Construction Manual” and duct manufacturer’s requirements.

D. Hangers Exposed to View: Threaded rod and angle or channel supports, stainless steel.

E. Support vertical ducts with angles or channel per drawing details and per duct manufacturer's recommendations; secured to the sides of the ducts,; support at each floor and at a maximum interval of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 FITTING AND ACCESSORY INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's " Thermoset FRP Duct Construction Manual" and according to the accessory manufacturer's instructions.

B. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

C. Install take-offs tight to duct wall surface with no projections into duct.

D. Provide flexible connections at inlet and discharge of air handling equipment.

E. Provide manual splitter dampers and volume dampers where indicated on the Drawings and as required to facilitate accurate volume control.

F. Provide gasketed access doors in ductwork for all dampers for inspection and maintenance.

G. Install volume dampers at points on duct systems where branches extend from larger ducts.

H. Set dampers to fully open position before testing, adjusting, and balancing.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. At outdoor-air intakes and mixed-air plenums.
   2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   3. At each change in direction.
   4. At each smoke damper and airflow measuring station.
   5. Upstream or downstream from turning vanes.
   6. Control devices requiring inspection.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

L. Label access doors according to Division 23 Section "HVAC and Plumbing Identification" to indicate the purpose of access door.

M. Install duct test holes where required for testing and balancing purposes.

3.6 **STARTUP AND COMMISSIONING**

A. Comply with Division 1 Sections and Section 23 05 93, Testing, Adjusting and Balancing of HVAC Systems.

B. Set volume control devices for approximate positions in preparation for final testing and balancing.

C. Start fan system and check for excessive leaks and vibration and correct.

D. Remake leaking joints and retest until leakage is less than maximum allowable.

E. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

F. Adjust volume-control dampers in ducts, outlets and inlets to achieve design air flow.

3.7 **DUCT CLEANING**

A. Comply with Division 1 Section "Cleaning".

B. Remove all loose materials and obstructions from interior of ducts.

C. Remove debris and waste materials resulting from installation.

END OF SECTION

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SECTION 23 34 23

POWER VENTILATORS – METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. **Scope:**
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install power ventilators complete with accessories.

B. **Coordination:**
   1. Review installation procedures under other Sections and coordinate the installation of times that must be installed with or before power ventilators complete with accessories.

1.3 QUALITY ASSURANCE

A. **Requirements of Regulatory Agencies:** Comply with applicable provisions of regulatory agencies below and others having jurisdiction.
   1. Local and State Building Codes and Ordinances.
      a. Ohio Building Code.
      b. Ohio Mechanical Code.
   2. National Fire Protection Association (NFPA).
   3. Underwriters' Laboratories, Incorporated (UL).
   4. National Electric Code (NEC).
   5. National Electric Manufacturers Association (NEMA).
   6. Air Movement and Control Association (AMCA).
   7. American National Standards Institute (ANSI).
   8. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

B. **AMCA Compliance**: Products shall comply with performance requirements and shall be licensed to use the AMCA – Certified Ratings Seal.

C. **NEMA Compliance**: Motors and electrical accessories shall comply with NEMA standards.

D. **UL Standard**: Power ventilators shall comply with UL 705.

E. **Electrical Components, Devices, and Accessories**: Listed and labeled as defined in NFPA 70, article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 **SUBMITTALS**

A. Submit the following in accordance with conditions of contract and Division 1 specification sections and the additional requirements below.

B. **Submit for approval the following:**
   1. Manufacturer's literature, illustrations, specifications, and engineering data to include the following:
      a. Dimensions.
      b. Materials of construction and coatings.
      c. Mounting details.
      d. Performance Data – AMCA approved fan curves, for each model specified.
      e. Motor ratings and electrical characteristics, plus motor and electrical accessories.
      f. Certified fan sound-power ratings.
      g. Prefabricated curb details.
   2. Drawings showing fabrication methods, assembly, installation details and accessories.
   3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. **Test Reports:** Submit the following test certifications for approval.
   1. AMCA Label.
   2. UL Label.

D. **Operation and Maintenance Manuals:**
   1. Submit to the ENGINEER complete Operation and Maintenance Manuals in accordance with Division 1.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections and Supplementary Requirements below.

B. **Delivery of Materials:**
   1. Items to be incorporated into roof construction shall be delivered to job site in sufficient time so as not to hold up construction.

1.6 **WARRANTY**

A. The manufacturer shall provide a written warranty on equipment, materials, parts and labor. The warranty period shall begin on the date of final acceptance of all the pumping equipment by the Owner. The warranty period shall be for a two-year duration. Warranty must be fully executed and signed by the CONTRACTOR and the manufacturer prior to final completion.

1.7 **COORDINATION**

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 **EXTRA MATERIALS**

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set for each belt-driven unit.

1.9 **JOB CONDITIONS**

A. Roof openings and penetrations shall be capped to prevent rain and snow from entering building prior to installation of units.

PART 2 - PRODUCTS

2.1 **GENERAL**

A. Fans shall be factory assembled, complete with fan wheel, fan housing, bearings, drives, drive guard, motor, motor base, unit base and vibration isolators, dampers and bird screens unless otherwise specified. All fans shall be provided with lugs, brackets or field supplied devices to allow the fan to be firmly bolted to the structure or fastened to specified vibration isolators. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.

B. All fans shall be statically and dynamically balanced prior to shipment from factory.

C. Where belt drives are used, motors shall be provided with adjustable bases. Adjustable sheaves and bases shall be selected so that the midpoint of the adjustable range matches the fan schedule data. Drives selected shall have a safety factor of 1.5 times motor horsepower.

D. All fans shall be AMCA certified for air performance and sound ratings tested in accordance with AMCA 300.

E. Motors shall be selected to be non-overloading for the entire fan curve range and for the reasonable expected temperature and humidity. Schedule motor sizes are minimum. If a larger motor is required for the fan proposed, the larger motor shall be provided at no additional cost.

F. All motors shall comply with Division 23 Section “HVAC Motors”.

G. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self tapping screws or other fastening methods that will damage the coating are not acceptable.

H. **SPECIAL REQUIREMENTS:** Unless scheduled otherwise, all upblast power ventilators/fans covered by this specification section shall be coated with an electrostatically applied, baked epoxy powder coating (such as Cook’s (Basis of Design) “Epoxy Powder Coating”) or equal. If not upblast, coating may be baked polyester powder coating.

2.2 **MANUFACTURERS**

A. Cook (Basis of Design)
B. Twin City
C. Aerovent
D. Hartzell

2.3 **FANS/VENTILATORS**

A. Centrifugal Roof Ventilators (Downblast)

1. Drive: Belt or direct driven as scheduled.
2. Housing: Spun aluminum.
3. Fan Wheel: Aluminum hub and wheel, backward-inclined blades.
4. Belt Drive Assembly (if scheduled as belt driven): Steel shaft, permanently lubricated ball bearings, cast iron adjustable pitch pulley, and fan motor isolated from airstream.
5. Motor: Heavy duty, ball bearing type with overload protection.
6. Features/Accessories:
    a. Disconnect switch
    b. Bird screens
    c. low leak backdraft dampers
    d. Other as scheduled.
7. Roof Curb Configuration: Self-flashing without cant strip and with mounting flange.
8. Roof Curb Height: 18 inches above finished roof.

B. Upblast Centrifugal Roof Exhaust Fans

1. Upblast type arrangement with isolated motor compartment.
2. Furnish unit with pre-wired NEMA 3R disconnect switch.
3. Drive: Belt or direct as scheduled.
4. Wind ban, fan housing and base; Reinforced and braced aluminum.
5. Housing: Spun aluminum with birdscreen.
6. Fan Wheel: Reinforced aluminum construction, backward inclined centrifugal.
7. Motor: Heavy duty, ball bearing, type with overload protection.
8. Roof Curb Configuration: Self-flashing without cant strip and with mounting flange.
9. Roof Curb Height: 18 inches above finished roof.
10. Features/Accessories:
    a. VFD or SSSC as scheduled.
    b. Low leak backdraft dampers as scheduled.
    c. Other as scheduled.

C. Centrifugal Square In-line Fans

1. Drive: Belt or direct as scheduled.
2. Housing: Aluminum.
3. Fan Wheel: Centrifugal, aluminum.
4. Belt Drive Assembly: Steel shaft, permanently lubricated ball bearings, adjustable pitch motor pulleys, motor insulated from airstream, belt guards.
5. Motors: Heavy duty, ball bearing type with overload protection.

6. Features/Accessories:
    a. Disconnect switch
    c. Low leak backdraft dampers as scheduled.
    d. Spring vibration isolators
    e. Other as scheduled.

2.4 **MOTORS**

A. Refer to Section 23 05 13, HVAC Motors for general requirements for factory-installed motors.

B. **Motor Construction**: NEMA MG 1, general purpose, continuous duty, Design B unless noted otherwise on drawings or as otherwise dictated by the special corrosion/classified area requirements of the project.

C. **Enclosure Type**: TEFC - Totally enclosed, fan cooled, TEAO, or as otherwise dictated by the special corrosion/classified area requirements of the project.

2.5 **SOURCE QUALITY CONTROL**

A. **Sound-Power Level Ratings**: Comply with AMCA 301, "methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA – Certified Ratings Seal.

B. **Fan Performance Ratings**: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 **INSPECTION**

A. CONTRACTOR shall examine the conditions under which the work is to be installed and notify the ENGINEER in writing and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. **Examine rails/curbs to receive exhausters for:**
    1. Level exhauster mounting service.
    2. Water tightness.
    3. Proper anchoring and flashing of prefabricated rails/curbs to roof deck.
    4. Unevenness, irregularities, and incorrect dimensions that would effect quality and execution of installation.

C. Do not proceed with installation of exhauster until rails/curbs conform to Specification requirements.

3.2 **INSTALLATION**

A. Install ventilator in accordance with manufacturer's installation instructions.

B. Install power ventilators level and plumb.

C. Secure roof-mounted fans to roof rails/curbs with stainless steel hardware. See Division 7 for installation of roof curbs.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers. Vibration-control devices are specified in Division 23 Section "Vibration Isolation."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section covering Identification.

3.3 CONNECTIONS

A. Install ducts adjacent to power ventilators to allow service and maintenance.

B. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Ductwork and Accessories."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Ground equipment according to Division 26.

E. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

A. Comply with Division 1 sections and Section 23 05 93, Testing, Adjusting and Balancing of HVAC Systems.

B. **Tests and Inspections**:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.

9. Shut unit down and reconnect automatic temperature-control operators.
10. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

E. **Starting Procedures**:
1. Energize motor and adjust fan to indicated rpm.
2. Measure and record motor voltage and amperage.
3. Replace fan and motor pulleys as required to achieve design airflow.
4. Refer to Division 23 Section "Testing, Adjusting, and Balancing of HVAC Systems" for testing, adjusting, and balancing procedures.

3.5 **ADJUSTING**

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.6 **CLEANING AND REPAIRING**

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION

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SECTION 23 34 24

HVAC PROPELLER FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Propeller fans.

1.2 ACTION SUBMITTALS

A. **Product Data:** For each type of product indicated.

B. **Shop Drawings:** Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. **Electrical Components, Devices, and Accessories**: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. **AMCA Compliance:** Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 PROPELLER FANS

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corporation.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Hartzell Fan Incorporated.

4. Loren Cook Company (Model XPD, Basis of Design).
5. PennBarry.
6. Greenheck.
7. Approved equal

B. **Housing and Venturi:** Minimum 14 gage steel sheet with flanged edges, welded wall base corners, corrosion resistant fasteners, and with Venturi.

C. **Fan Wheel:** Statically and dynamically balanced aluminum blades fastened to a painted steel hub keyed to shaft.

D. **Fan Drive:** TENV Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Fan Drive:

1. Resiliently mounted to housing.
2. Statically and dynamically balanced.
3. Selected for continuous operation at maximum rated fan speed and motor horsepower.
4. Service Factor Based on Fan Motor Size: 1.5.

F. **Finish:** Baked Polyester powder.

G. Accessories/Other Features:

1. Wall Sleeve: Minimum 18 gage Galvanized steel (and finished same as fan) to match fan and accessory size.
2. Weathershield Hoods: Galvanized steel to match fan and accessory size, finished same as fans, with birdscreen.
3. Disconnect Switch: Non-fusible type, with thermal-overload protection, factory wired through an internal conduit. Disconnect to be constructed to same corrosion resistance as fan.
4. EC motor controller capable of
5. Other as scheduled.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: TENV.

2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300,

"Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
5. Adjust damper linkages for proper damper operation.
6. Verify lubrication for bearings and other moving parts.

7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
8. Shut unit down and reconnect automatic temperature-control operators.
9. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

END OF SECTION

SECTION 23 34 25

POWER VENTILATORS – FRP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install power ventilators complete with accessories.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of times that must be installed with or before power ventilators complete with accessories.

1.3 QUALITY ASSURANCE

A. **Requirements of Regulatory Agencies:** Comply with applicable provisions of regulatory agencies below and others having jurisdiction.

1. Local and State Building Codes and Ordinances.
    a. Ohio Building Code.
    b. Ohio Mechanical Code.
2. National Fire Protection Association (NFPA).
3. Underwriters' Laboratories, Incorporated (UL).
4. National Electric Code (NEC).
5. National Electric Manufacturers Association (NEMA).
6. Air Movement and Control Association (AMCA).
7. American National Standards Institute (ANSI).
8. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
9. ASTM D4167-97-Standard Specification for Fiber-Reinforced Fans and Blowers.

B. **AMCA Compliance:** Products shall comply with performance requirements and shall be li-censed to use the AMCA – Certified Ratings Seal.

C. **NEMA Compliance:** Motors and electrical accessories shall comply with NEMA standards.

D. **UL Standard:** Power ventilators shall comply with UL 705.

E. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 SUBMITTALS

A. Submit the following in accordance with conditions of contract and Division 1 specification sections and the additional requirements below.

B. Submit for approval the following:

1. Manufacturer's literature, illustrations, specifications, and engineering data to include the following:
    a. Dimensions.
    b. Materials of construction and coatings.
    c. Mounting details.
    d. Performance Data – AMCA approved fan curves, for each model specified.
    e. Motor ratings and electrical characteristics, plus motor and electrical accessories.
    f. Certified fan sound-power ratings.
    g. Prefabricated curb details.
2. Drawings showing fabrication methods, assembly, installation details and accessories.
3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Test Reports: Submit the following test certifications for approval.

1. AMCA Label.
2. UL Label.

D. Operation and Maintenance Manuals:

1. Submit to the ENGINEER complete Operation and Maintenance Manuals in accordance with Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections and Supplementary Requirements below.

B. Delivery of Materials:

1. Items to be incorporated into roof construction shall be delivered to job site in sufficient time so as not to hold up construction.

1.6 WARRANTY

A. The manufacturer shall provide a written warranty on equipment, materials, parts and labor. The warranty period shall begin on the date of final acceptance of all the equipment by the Owner. The warranty period shall be for a five year duration. Warranty must be fully executed and signed by the CONTRACTOR and the manufacturer prior to final completion.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

1.9 JOB CONDITIONS

A. Roof openings and penetrations shall be capped to prevent rain and snow from entering building prior to installation of units.

PART 2 - PRODUCTS

2.1 GENERAL

A. Fans shall be factory assembled, complete with fan wheel, fan housing, bearings, drives, drive guard, motor, motor base, unit base and vibration isolators, dampers and bird screens unless otherwise specified. All fans shall be provided with lugs, brackets or field supplied devices to allow the fan to be firmly bolted to the structure or fastened to specified vibration isolators. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.

B. All fans shall be statically and dynamically balanced prior to shipment from factory.

C. Where belt drives are used, motors shall be provided with adjustable slide bases. Adjustable sheaves and slide bases shall be selected so that the midpoint of the adjustable range matches the fan schedule data. Drives selected shall have a safety factor of 1.5 times motor horsepower.

D. All fans shall be AMCA certified for air performance and sound ratings tested in accordance with AMCA 300.

E. Motors shall be selected to be non-overloading for the entire fan curve range and for the reasonable expected temperature and humidity. Schedule motor

sizes are minimum. If a larger motor is required for the fan proposed, the larger motor shall be provided at no additional cost.

F. All motors shall comply with Division 23 Section "HVAC Motors".

G. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self-tapping screws or other fastening methods that will damage the coating are not acceptable.

H. SPECIAL REQUIREMENTS: All power ventilators/fans covered by this specification section shall be properly outfitted for use in or for handling air from their respective areas, and they shall be built/outfitted for high humidity exhaust.

2.2 MANUFACTURERS

A. Cook (Basis of Design)

B. Twin City

C. Aerovent

D. Hartzell

E. AxiJet (Basis of Design)

2.3 FRP FANS/VENTILATORS

A. Upblast Centrifugal Roof Exhaust Fans

1. Fan shall be a fiber-reinforced polyester resin, roof mounted, direct driven, upblast centrifugal exhaust ventilator.

2. The fan shall be of bolted construction with stainless steel fasteners. Fasteners in the airstream shall be encapsulated in resin to further protect against corrosion. Structural parts shall be made of either fiber-reinforced polyester resin or epoxy coated steel. All fiberglass resin to be formulated to achieve a Class I flame spread below 25. All resin surfaces shall have additional chemical, flame and ultraviolet protective top coating. The fan base shall have solid curb cap corners for maximum leak protection. Motor, bearing and drives shall be mounted on a heavy duty epoxy coated steel power assembly, and enclosed in a ventilated motor compartment for protection against corrosive airstream. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. A neoprene shaft seal shall be provided. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.

3. Wheel shall be centrifugal airfoil backward inclined, constructed of fiber-reinforced vinylester resin, molded and formed in one solid piece. Wheels constructed of separately molded shroud, floats and backplate and then assembled are considered unacceptable. Wheel shall include a precision machined aluminum hub encapsulated in resin. Wheel inlet shall overlap an aerodynamic inlet cone to provide maximum performance and

efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

4. Motor shall be Totally Enclosed NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

OTHER FEATURES:

- Bird Screen – 304 Stainless.
- Shaft – 304 stainless steel.
- Curb adapter – 304 stainless steel.

B. High Blow/Plume Type Exhaust Roof Fans

1. MK Plastics Axijet with matching inlet plenum.

2. **GENERAL**

A. Base fan performance at standard conditions (density 0.075 Lb/ft^3).
B. Each fan shall be direct driven in AMCA arrangement 4 or 8, according
C. Fans to be equipped with lifting lugs.
D. Fan stand shall be coated steel with a minimum of 4-6 mil electrostatically applied Plastifer baked Polyester powder coating (or equal).
E. Fasteners to be 304 stainless steel.

3. **FAN HOUSING AND OUTLET**

A. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence. Casings to be smooth exterior and resin rich interior.

B. Fan housing shall be manufactured in specifically formulated resins,for maximum corrosion resistance, and reinforced with fiberglass for structural strength. Fastening bolts holding the casing to the support plate are to be encapsulated in FRP. No uncoated metal fans parts in the corrosive air stream will be tolerated.

C. A bifurcated fiberglass reinforced plastic (FRP) discharge nozzle shall be supplied by the fan manufacturer and be designed to efficiently handle an outlet velocity of up to 7,000 FPM. The discharge shall include a venturi and fiberglass wind band to induce ambient air.

D. All fiberglass parts shall include UV inhibitors in the resins to prevent chalking from the sunlight. Flame retardancy of 25 or less, is standard.

E. A graphite liner and grounding strap shall be included to remove any possible build up of static electricity, if noted on the equipment schedule.

F. An integral fan housing drain shall be used to drain rainwater when the fan is de-energized.

G. A bolted housing access door shall be supplied for impeller inspection.

H. Standard finish color to be light gray.

I. Hub seal to be neoprene or Teflon, if noted on the equipment schedule, but supplied as best suited for project duty.

4. **FAN IMPELLER**

A. Impellers shall be solid, molded FRP with backward inclined blades. A metal backplate integral to the FRP impeller and encapsulated in resin shall have the hub extending to the outside of the fan housing. A tight fitting removeable FRP cap shall cover the impeller end of the shaft. Impellers manufactured in coated steel are not acceptable.

5. **FAN INLET ELBOW/PLENUM**

A. Inlet plenum shall be provided as shown on drawings. The plenum shall be equipped with a bypass air damper and fiberglass reinforced plastic (FRP) weather cowl and birdscreen, for introducing outside air at roof level upstream of the fan. As standard, the plenum shall be constructed of double wall, thermally and acoustically insulated, 1" thick K-Kore fiberglass panels, bonded, reinforced and sealed together to prevent noise and air leakage.

B. Bypass plenum shall be mounted on an insulated curb. A combination integral fan platform plenum curb shall be provided by the fan manufacturer, if shown on the equipment schedule and project drawings.

C. Inlet plenum to be attached to the fan inlet by a flexible FPVC connector, provided by the fan manufacturer.

D. Bypass air damper(s) shall be opposed-blade, airfoil design, constructed of fiberglass reinforced plastic (FRP), with linkage hardware installed in the side frame. Each bypass damper shall be housed inside a fiberglass reinforced plastic (FRP) weather cowl and birdscreen, to prevent the possibility of rainwater entrainment.

E. Fan isolation damper shall be parallel-blade, airfoil design, constructed of fiberglass reinforced plastic (FRP), with linkage hardware installed in the side frame. Each isolation damper shall be housed inside a fiberglass reinforced plastic (FRP) damper enclosure, bolted to the bypass air plenum with a round slip connection at one end for fan inlet attachment.

F. All dampers shall have an extended control shaft for electronic, pneumatic or manual control actuation.

6. **FAN MOTORS AND DRIVE**

A. Motors to be premium efficiency, standard NEMA frame, TEFC with a 1.15 service factor. A factory mounted disconnect switch shall be provided for each fan.

B. Fan shall be AMCA arrangement 4. Fan motor, coupling, and bearings shall all be outside the contaminated exhaust, and be capable of replacement without disassembling fan.

3. **INSTALLATION**

A. Install fans as indicated on the contract drawings.

B. Install FPVC flexible connections with stainless steel straps, provided by the fan manufacturer, between fan inlet and bypass plenum. Insure that the flexible connection is at least 6 inches wide.

C. Pipe housing drain to the nearest drain.

D. Fans shall be mounted on seismically restrained spring vibration isolators, provided by the fan manufacturer, selected based on fan size, loading conditions and deflection requirements per the fan schedule and specification.

E. Install fans in accordance with manufacturers instructions, applicable specification and code requirements.

OTHER FEATURES:

- Motor Cover - All fiberglass with louvers positioned for horizontal or vertical mounting.
- Hardware - Type 304 stainless steel.
- Lifting lugs.
- Shaft seal.
- Access door.
- Drain and plug.
- Spring vibration isolators.

D. BACKWARD-INCLINED SWSI CENTRIFUGAL FANS

1. Fan shall be a fiber-reinforced polyester resin, single width, single inlet, backward inclined airfoil, arrangement 10, belt driven Class II centrifugal blower.

2. Fan shall bear the AMCA certified ratings seal for sound and air performance.

3. The fan shall be of bolted construction with stainless steel fasteners. Fasteners in the airstream shall be encapsulated in resin to further protect against corrosion. Structural parts shall be made of either fiber reinforced polyester resin or epoxy coated steel. All fiberglass resin to be formulated to achieve a Class I flame spread below 25. All resin surfaces shall have additional chemical, flame and ultraviolet protective top coating. A neoprene shaft seal shall be provided. The fan housing shall be field rotatable to any one of eight discharge positions and shall have an outlet discharge flange for duct connection. Unit shall have the motor and drives enclosed in an OSHA motor compartment. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.

4. Wheel shall be centrifugal airfoil backward inclined, constructed of fiber reinforced vinylester resin, molded and formed in one solid piece of the specified rotation. Wheels constructed of separately molded shroud, floats and backplate and then assembled are considered unacceptable. Wheel

shall include a precision machined aluminum hub encapsulated in resin. Wheel inlet shall overlap an aerodynamic inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

5. Motor shall be NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

6. Construction shall be heavy duty regreasable ball or roller type in a cast iron pillow block housing selected for a minimum L50 life in excess of 250,000 hours at maximum cataloged operating speed.

7. Blower shaft shall be AISI C-1045 hot rolled and accurately turned, ground and polished with an FRP sleeve in the airstream for protection. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.

8. Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

OTHER FEATURES:

- Weather Cover - Covers drive and shaft, epoxy coated steel or FRP.
- Vibration Isolators Rails - For horizontal mount, with corrosion resistant spring type isolators.
- Drain - FRP pipe assembled in housing, 1" capped male fitting.
- Electrical Grounding - Air stream surfaces are coated with a carbon rich coating with grounding straps to the motor frame. User must properly ground the equipment at the installation.
- Access Door - Raised, bolted door held in place with stainless steel bolts and gasketed.
- Inspection Door - Small opening for visual inspection of wheel. Gasketed and held in place with stainless steel bolts.
- Flanged Inlet/Outlet - Solid fiberglass flanges, available drilled or undrilled.
- Special Hardware - 304 stainless steel or Monel.
- 45 degree discharge hood with 304 stainless steel birdscreen.

2.4 MOTORS

A. Refer to Section 23 05 13, HVAC Motors for general requirements for factory-installed motors.

B. **Motor Construction:** NEMA MG 1, general purpose, continuous duty, Design B unless noted otherwise on drawings or as otherwise dictated by the special corrosion/classified area requirements of the project.

C. **Enclosure Type:** TEFC - Totally enclosed, fan cooled, TEAO, or as otherwise dictated by the special corrosion/classified area requirements of the project.

2.5 SOURCE QUALITY CONTROL

A. **Sound-Power Level Ratings:** Comply with AMCA 301, "methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA – Certified Ratings Seal.

B. **Fan Performance Ratings:** Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the work is to be installed and notify the ENGINEER in writing and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Examine rails/curbs to receive exhausters for:

1. Level exhauster mounting service.
2. Water tightness.
3. Proper anchoring and flashing of prefabricated rails/curbs to roof deck.
4. Unevenness, irregularities, and incorrect dimensions that would affect quality and execution of installation.

C. Do not proceed with installation of exhauster until rails/curbs conform to Specification requirements.

3.2 INSTALLATION

A. Install ventilators in accordance with manufacturer's installation instructions.

B. Install power ventilators level and plumb.

C. Secure roof-mounted fans to roof rails/curbs with stainless steel hardware. See Division 7 for installation of roof curbs.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers. Vibration-control devices are specified in Division 23 Section "Vibration Isolation."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section covering Identification.

3.3 CONNECTIONS

A. Install ducts adjacent to power ventilators to allow service and maintenance.

B. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Ductwork and Accessories."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Ground equipment according to Division 26.

E. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

A. Comply with Division 1 sections and Section 23 05 93, Testing, Adjusting and Balancing of HVAC Systems.

B. **Tests and Inspections:**

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.

6. Adjust damper linkages for proper damper operation.

7. Verify lubrication for bearings and other moving parts.

8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.

9. Shut unit down and reconnect automatic temperature-control operators.

10. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

E. **Starting Procedures:**

1. Energize motor and adjust fan to indicated rpm.

2. Measure and record motor voltage and amperage.

3. Replace fan and motor pulleys as required to achieve design airflow.

4. Refer to Division 23 Section "Testing, Adjusting, and Balancing of HVAC Systems" for testing, adjusting, and balancing procedures.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.6 CLEANING AND REPAIRING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION

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SECTION 23 37 25

EXTERIOR WALL LOUVERS

PART 1-GENERAL

1.1 SECTION INCLUDES

A. Exterior wall louvers.

1.2 SUBMITTALS

A. Submittals are required and shall include scheduled material, sizes, quantities, and finish.

1.3 QUALITY ASSURANCE

A. AMCA Standard 511.

PART 2-PRODUCT

2.1 MANUFACTURERS

A. Ruskin Model EME520DD (Basis of Design)
B. AIROLITE equal
C. Construction Specialties equal
D. American Warming equal

2.2 COMPONENTS/FEATURES

A. Rectangular Double Drainable Blade Wind Driven Rain Resistant Stationary Wall Louvers
   1. Wind driven rain resistant, 5" deep, aluminum construction.
   2. Aluminum bird screen on outside (to match louver color) suitably braced to prevent sagging.
   3. Frame shall be constructed of minimum 0.081" thick 6063T5 extruded aluminum.
   4. Blades shall be constructed of minimum 0.063" thick 6063T5 extruded aluminum. Blades shall be the sight proof type, positioned at approximately 2" centers.
   5. Finish shall be factory applied 2-coat, 70% PVDF finish. Color shall be selected by Architect from a manufacturer's standard colors.
   6. Provide and install with extended sills, 16 gage galvanized steel sleeves, and required angles/hardware, and provide with motor operated or counterbalanced gravity dampers as scheduled or noted. Damper motor operators by temperature control contractor.

PART 3-EXECUTION

3.1 INSTALLATION

A. Louvers to be furnished and installed by the Mechanical Contractor.

END OF SECTION

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SECTION 23 73 34

OUTDOOR H&V UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes packaged heating and ventilating units with no heat or with electric heat for outdoor installation and are to be 100% outside air. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in PART 2 of this specification.

1.2 SUBMITTALS

A. **Product Data:** For each type or model, include the following:

1. Complete fan performance curves for supply air, with system operating conditions indicated, as tested in an AMCA Certified Chamber.
2. Sound performance data for supply air, as tested in an AMCA Certified chamber.
3. Motor ratings, electrical characteristics and motor and fan accessories.
4. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
5. Estimated gross weight of each installed unit with curb and accessories.
6. Installation, Operating and Maintenance manual (IOM) for each model.
7. Remote Panel description to include all functions.

1.3 QUALITY ASSURANCE

A. **Source Limitations:** Obtain units with integral heating with all appurtenant components or accessories from a single manufacturer.

B. **Product Options:** Drawings must indicate size, profiles and dimensional requirements of units and are to be based on the specific system indicated. Refer to Division 1 Section "Product Requirements".

C. Certifications:

1. Entire unit shall be ETL Certified per U.L. 1995 and bear an ETL mark.
2. Indirect gas-fired heaters shall be ETL certified as a component of the unit.

1.4 COORDINATION

A. Coordinate size and location of all building penetrations required for installation of each unit and associated ducting, plumbing and electrical systems.

B. Coordinate sequencing of construction of associated plumbing, HVAC, and electrical supply.

PART 2 -PRODUCTS

2.1 OTHER REQUIREMENTS

A. GENERAL

1. Units shall be built to the level of quality as herein specified and to the description of the unit schedule on the drawings.

2. Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.

3. Unless stated otherwise, units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close proximation to the intent of this specification will not be considered equal.

4. Pre-wired units shall bear an approved label with all the necessary identification marks, and electrical data.

5. All electrical circuits shall undergo a dielectric strength test and shall be factory tested and checked as to proper function.

6. The units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

7. Units shall be ETL Approved and as manufactured by Engineered Air and be base bid. Alternate products must show savings and clearly indicate all areas where they do not meet specified product.

B. UNIT CONSTRUCTION

1. Unit casing shall be of minimum 18 gauge galvanized steel sheet metal with two component epoxy polyurethane paint topcoat (Level 3-2, ASTM B-117 1500 hour salt spray rated) on the exterior.

2. All high pressure (5" w.c. to 9" w.c.) fan sections shall be constructed of 14 gauge metal. Continuous high pressure sealant shall be provided between all panels.

3. All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

4. Unit interior shall be provided with a minimum 22 gauge solid, 304 stainless steel sheet metal.

5. Screws and rivets shall be stainless steel.

6. Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, and burner compartments. Access doors for airside compartments to be deluxe welded type. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

7. Units shall be provided with hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units.

8. All units shall be internally insulated with minimum 1" thick, 1 1/2 lb./cu.ft. density insulation.

9. Units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1" stainless steel inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" with three break interlocking design; outer wall panels extend a minimum of ¼" below the floor panel; drain trap(s) connections for field supply and installation of drain traps.

10. Provide full perimeter roof mounting curb of heavy gauge sheet metal (with same exterior and interior materials and coatings as supported unit), to support the units at above the adjacent finished roof surfaces, and complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 1" upturn on inner perimeter, to provide a complete seal against the elements. External insulation and flashing of roof-mounting curb shall be provided by the Roofing Subcontractor.
11. Provide units with matching purge plenums (as scheduled) complete with purge inlet dampers, exhaust dampers, and supply air isolation dampers, all with operators.
12. Provide units with air intake hoods with birdscreen, all coated to match unit casing.

C. FANS AND MOTORS

1. Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

2. Fans and housings shall be epoxy painted for corrosion resistance.

3. Forward curved, airfoil, and/or BI fans shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings.

4. Airfoil and BI fans shall be direct drive plenum type configuration where noted in schedules. Thrust restraint isolators shall be provided parallel to the shaft centerline when required to minimize axial movement and bending movements of the blower assembly(s). Fan wheels to be aluminum.

5. Drives shall be adjustable on fans with motors 7 1/2 HP or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

6. Provide variable air volume and/or multiple speed fan control for units as per schedule, via adjustable speed drive.

7. Adjustable frequency drives used shall be NEMA 4X rated and be labeled by an approved testing agency such as UL. VFD'S to meet Section 23 09 10 also.

8. Units with VFD's shall have manual VFD bypass switches which lock the out VFD, fan runs on maximum set volume. Bypass switch and all interlock contacts are factory mounted and pre-wired.

9. Line and load reactors required for all 460 volt applications.

10. Drive shall be factory supplied and installed.

11. Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be neoprene-in-shear type for single 9" to 15" diameters forward curve fans. All other fans shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

12. Provide single extended grease line from far side to access side bearing.

13. Fan motors shall be TEFC (totally enclosed fan cooled) Super E high efficiency.

D. ELECTRIC HEAT SECTION

1. Units capable of heating shall have ETL listed electric heating sections with SCR control..

2. Electric heaters to have nickel-chromium element coils with protective screens, discharge air control with room override, and low limit auto bypass.
3. Factory tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the electric heating section is certified.

E. Controls:

1. Controllers shall include the following standard features:

   - Service analyzer with diagnostic lights for ease of set-up and service.
   - Self check on start-up to make sure air proving and discharge air sensors are operating within design tolerances to make sure air switches are not shorted or jumpered.

- Low kw start.
- Inlet damper operation.
- Controlled heating section start-up and shut down.

2. Heating control function shall be modulating discharge air complete with sensor and space mounted thermostat for room override.

3. Discharge air sensor shall be field mounted in supply ductwork.

4. Provide a make up air reverse airflow high limit switch in series with the standard high limit switch mounted in the blower discharge.

F. FILTERS

1. Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side.

2. 4" Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Units exposed to 100% outside air shall have permanent re-usable metal enclosing frame. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

3. Where the filter gauges are provided on outdoor units they shall be mounted inside of a weatherproof enclosure with viewing window.

G. DAMPERS

1. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080” in thickness. Damper frame shall be 4” deep x 1", with duct mounting flanges on both sides of frame. Damper frame shall have a 2" mounting flange on the rear of the damper when installed as Extended Rear Flange install type. Aluminum frame shall be clear anodized to a minimum thickness of 0.7 mil deep. Frame shall be assembled using stainless steel screws. Welded frames shall not be acceptable.

2. Blades shall be maximum 6" deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06”, clear anodized to a minimum thickness of 0.7 mil deep. Aluminum end caps shall be press fitted to blade ends in order to seal hollow interior and reduce air leakage rates. End caps shall be clear anodized. All blades shall be symmetrically pivoted.

3. Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

4. Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent

shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.

5. Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.

6. Hexagonal control shaft shall be 7/16". It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be stainless steel.

7. Linkage hardware shall be aluminum and stainless steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with stainless steel cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.

8. Dampers shall be AMCA rated for Leakage Class 1A at 1 in. w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

9. Acceptable product shall be TAMCO Series 1500 SW Enhanced Air-Foil Control Damper, as manufactured by T. A. Morrison & Co., Inc. (Tel: 1-800-561-3449, USA & Canada).

H. FACTORY SUPPLIED CONTROLS/WIRING

1. Provide a system of motor control (multiple-speed or variable speed as scheduled), including all necessary terminal blocks, motor contactors/VFD’s, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

2. Units shall include high limit and low limit.

3. Fire alarm circuits (where required) shall be powered from a relay in the unit circuitry.

4. Provide unit with exterior convenience outlet (wired by EC).

5. Provide unit with properly corrosion resistant (suitable for treatment plant environment) airflow measuring station with transducer.

6. Factory installed and wired non-fused disconnect switch with NEMA 4X rating.

7. Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation. A NEMA 4X remote operating station (with Lamicoid face, unit on/off/auto switch, XP stat, unit “on” light, unit clogged filter light, and unit alarm light) is to be provided for each unit. GTRAC controller (with integral reference setpoint) shall control the unit and shall modulate the electric heat to maintain the required

discharge air temperature. When the room temperature calls for heat, the discharge air temperature will be reset to a higher value to satisfy the room heating demand. When the unit is off, the OA damper is to close and the supply air damper to close. The purge section dampers to be placed/operated as required when the unit is off or on. Heating to be locked out above an adjustable ambient temperature.

8. Electrical enclosures shall be minimum NEMA 4X rated to protect against a corrosive environment.

9. Exposed sensors shall be either conformal coated or air dry phenolic coating.

10. Unit wiring shall be type THHN and shall be run in aluminum conduit with liquid tight fittings.

I. OTHER FEATURES

1. Remote control panel with NEMA type switches and lights.
2. For units serving classified areas, explosion proof space stat to be mounted remotely from remote panel.
3. Epoxy coated roof curbs.
4. Any bare metal not stainless steel, and all sensors not protected, to be Heresite or conformal coated.
5. Aluminum fan wheels.
6. As scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.

B. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.3 CONNECTIONS

A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.

1. Not used.
2. Duct installation and connection requirements are specified in Division 23 of this document.
3. Electrical installation requirements are specified in Division 26 of this document.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.5 START-UP SERVICE

A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.6 DEMONSTRATION AND TRAINING

A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

END OF SECTION

SECTION 23 74 15

PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged roof top units.

B. Unit controls.

C. Roof mounting curbs and bases.

1.2 REFERENCES

A. ARI 210 - Unitary Air-Conditioning Equipment.

B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

C. NFPA 70 - National Electrical Code.

D. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

1.3 SUBMITTALS FOR REVIEW

A. **Section 01300 – Submittals.** Procedures for submittals.

B. **Shop Drawings.** Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. **Product Data.** Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

D. **Section 01300 – Submittals.** Submittals for information.

E. Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

F. **Section 01700 - Contract Closeout.** Submittals for project closeout.

G. **Operation and Maintenance Data.** Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.4 REGULATORY REQUIREMENTS

A. **Products Requiring Electrical Connection.** Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND PROTECTION

A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.6 **WARRANTY**

A. Section 01700 - Contract Closeout.

B. Provide a five-year warranty to include coverage for refrigeration compressors and a ten year warranty on the gas heat exchanger.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. Trane

B. Johnson Controls

C. Daikin (Basis of Design)

2.2 **AIR CONDITIONING UNITS**

A. **General.** Roof mounted units having DX cooling and electric heat as scheduled. Units to be 100% run-tested before leaving the factory.

B. **Description.** Self-contained, packaged, factory assembled and prewired, consisting of curb, cabinet and frame, supply fan, DDC controls, air filters, refrigerant cooling coils and compressor(s), economizer, condenser coil and condenser fan, and electric heating sections.

C. **Electrical Characteristics**. All unit power shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry to minimize roof penetrations and avoid unit field modifications. Separate side and bottom openings shall be provided for the control wiring.

2.3 **FABRICATION**

A. **Cabinet.** Galvanized steel with baked enamel finish, with hinged access doors.

B. **Insulation.** Minimum ¾ inch thick foil faced glass fiber with edges protected from erosion (thicker if required to eliminate condensation), minimum R=3.6.

C. **Supply Fan.** Forward curved centrifugal type, resiliently mounted with V-belt or direct drive, adjustable variable pitch motor pulley (if belt drive), and rubber isolated mounted motor.

D. **Air Filters.** Two inch thick, pleated MERV 8 throwaways.

2.4 **EVAPORATOR COIL**

A. Provide copper tube aluminum fin coil assembly with corrosion protected galvanized drain pan and connection.

B. Provide capillary tubes or thermostatic expansion valves for units 7.5 tons cooling capacity and larger.

2.5 COMPRESSOR

A. Provide hermetic scroll compressor(s), 3600 rpm maximum, resiliently mounted with positive lubrication, low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter drier.

B. Timed off circuit to delay compressor start.

2.6 CONDENSER COIL

A. Provide copper tube aluminum fin coil assembly with sub cooling rows and coil guard.

B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.

2.7 ELECTRONIC DUAL ENTHALPY AUTOMATIC ECONOMIZER

A. Outdoor and return air dampers that are interlocked and positioned by a fully-modulating, spring-return damper actuator. The maximum leakage rate for the outdoor air intake dampers shall be designed to meet ASHRAE 90.1- 2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure. During economizer operation, a mixed-air temperature control shall modulate the outdoor and return air damper assembly to prevent the supply air temperature from dropping below 55°F. Changeover from compressor to economizer operation shall be provided by an integral electronic enthalpy control that feed input into the basic module. The outdoor intake opening shall be covered with a rain hood that matches the exterior of the unit.

2.8 OPERATING CONTROLS

A. **Unit Controls.**

1. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.

2. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit should any of the following standard safety devices trip and shut off compressor:

   a. Loss of charge/Low-pressure switch.
   b. High-pressure switch.
   c. Freeze-protection thermostat, evaporator coil. If any of the above safety devices trip and LED (light-emitting diode) indicator shall flash a diagnostic code that indicates which safety switch has tripped.

3. Unit shall incorporate “AUTO RESET” compressor over temperature, over

current protection.

4. Unit shall operate with conventional thermostat designs and have low voltage terminal strip for easy hook-up.

5. Unit control board shall have on-board diagnostics and fault code display.

6. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to 0 °F.

7. Control board shall monitor each refrigerant safety switch independently.

8. Control board shall retain last 5 fault codes in non-volatile memory, which will not be lost in the event of a power loss.

2.10 **OTHER FEATURES**

A. Disconnect Switch.

B. BACnet DDC control interface.

C. Phase failure monitor.

D. Other as scheduled.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. Verification of existing conditions prior to beginning work.

B. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings and as illustrated by the manufacturer.

C. Verify that proper power supply is available.

3.2 **INSTALLATION**

A. Install in accordance with manufacturers' instructions.

B. Install in accordance with NFPA 90A.

END OF SECTION

SECTION 23 82 39

ELECTRIC UNIT HEATERS – PROPELLER TYPE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Scope.

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all heating units complete with accessories.

B. Coordination.

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with heating equipment.

1.3 QUALITY ASSURANCE

A. **Reference Standards**. Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. Local and State Building Codes and Ordinances.
   a. Ohio Building Code.
   b. Ohio Mechanical Code.
2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
3. Air Movement and Control Association (AMCA).
4. National Electrical Code (NEC).
5. National Electrical Manufacturers Association (NEMA).
6. Underwriters Laboratories (UL).

B. **Manufacturer's Qualifications.** Manufacturer shall have a minimum of 5 years experience in producing substantially similar type equipment and shall show evidence of at least 5 installations in satisfactory operation.

1.4 SUBMITTALS

A. **Submit the following in accordance with conditions of contract and Division 1 specification sections:**

1. Manufacturer's literature, illustrations, specifications, and engineering data including the following:
   a. Dimensions.

b. Capacities.
c. Materials of Construction.
d. Finishes.

2. Drawings showing fabrication methods, assembly, installation details and accessories.

B. **Operation and Maintenance Data:** Comply with Section 01781, Operations and Maintenance Data, and the additional requirements below: Submit complete manuals including:

1. Copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of materials shall be in accordance with conditions of contract and Division 1 specification sections and Supplementary Requirements below.

B. Delivery of Materials.

C. Unit heaters shall come completely assembled and protected.

1. Suction and discharge parts shall be protected against entry of foreign objects.

D. Storage of Materials.

1. Store units in a clean, dry area, out of the weather.
2. Cap all pipe connections.
3. Units shall remain in crate till time of actual installation.
4. Units shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Minimum performance data for each unit shall be as shown on the schedule presented on the Drawings.

2.2 ELECTRIC UNIT HEATERS (CORROSION RESISTANT/WASHDOWN)

A. **Available Manufacturers.** Subject to compliance with requirements manufacturers offering products that may be incorporated into work include, but not limited to, the following:

1. Markel
2. Q-Mark
3. Berko
4. Brasch
5. Chromalox
6. Indecco UCI (Basis of Design)

B. **Description**. An industrial grade assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

C. Comply with UL 2021.

D. Cabinet shall be constructed of heavy 18 gauge cold-rolled steel structurally formed to provide strength and rigidity with powder coated, phosphated or epoxy finish with removable panels for maintenance access to controls.

E. **Airstream Surfaces.** Surfaces in contact with the airstream shall comply with requirements in the in-force version of ASHRAE 62.1.

F. **Discharge.** Adjustable louvers.

G. **Electric-Resistance Heating Elements.** Non-glowing deign consisting of 80/20 nickel-chromium resistance wire, embedded in magnesium oxide and enclosed in a metal sheath, to which metal plated fins are copper brazed. Elements to be free from expansion noise and 60-Hz hum. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: Auto reset type limit control to de-energize the heater.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

H. **Fan**. Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

I. **Fan Motors.** Comply with requirements in Division 15 Section "HVAC Motors."

J. **Motor Type.** Permanently lubricated with integral thermal overload protection.

K. Control Devices.

1. As called for on drawings.

L. **Accessories/Other Features.** Wall mounting bracket (for wall mounted units) and prewired disconnect switch.

M. Capacities and Characteristics. See drawings.

2.3 ELECTRIC UNIT HEATERS (EXPLOSION PROOF)

A. **Available Manufacturers**: Subject to compliance with requirements manufacturers offering products that may be incorporated into work include, but not limited to, the following:

1. Markel
2. Q-Mark
3. Berko
4. Brasch
5. Chromalox
6. Indecco TRIAD (Basis of Design)

B. **Description**: Industrial grade, corrosion resistant stainless steel assembly including sealed casing, 316 stainless finned coil, and properly rated fan and motor in horizontal discharge configuration with adjustable discharge louvers. Units to be UL and cUL approved for moist environments.

C. Comply with UL 2021.

D. Cabinet shall be constructed of heavy 16 gauge 304 stainless steel structurally formed to provide strength and rigidity with removable panels for maintenance access to controls.

E. **Discharge**: Adjustable louvers, stainless steel.

F. **Fan Motor Assembly**: Totally enclosed, epoxy coated,UL Recognized motor with permanently lubricated ball bearings for longer life. Designed to resist moisture and corrosion. Factory-wired to NEMA 4x enclosure. Fitted with a powder coated, aluminum fan blade suitable for corrosive salt spray environments.

G. **Control Enclosure**: The non-metallic enclosure, which houses the element terminals and built-in controls, will not rust and meets NEMA 4x hose-down requirements.

H. **Built-in Controls**: Include automatic reset overtemperature cutout, fan delay relay, controlling contractor, transformer for 24-volt control circuit, terminal block for field wiring and a separate motor contractor (when required).

I. **Accessories/Other Features**: Stainless steel wall mounting bracket (if wall mounted), suspension kit, stat as scheduled, shown, or noted, pilot light, and pre-wired disconnect switch.

J. Capacities and Characteristics: See drawings.

PART 3 EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. CONTRACTOR shall examine units for damage prior to installation and correct if necessary as recommended by manufacturers.

3.2 INSTALLATION

A. Equipment shall be installed in accordance with manufacturer's recommendations. Electrical connections in accordance with the requirements of the other related sections.

B. Install units level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers or spring hangers.

D. Suspend propeller unit heaters from structure with vibration isolators. Vibration isolators are as specified in Division 23 Section "Vibration Isolation".

E. Install wall mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

F. Install heating equipment to comply with NFPA 90A.

3.3 CONNECTIONS

A. Comply with safety requirements in UL 1995.

B. Ground equipment according to Division 26.

C. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

A. Set air deflectors for proper air delivery.

B. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

C. Test and adjust controls and safeties.

D. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.5 CLEANING AND REPAIRING

A. Remove paint splatters and other spots, dirt and debris. Repair damaged finish to match original finish.

END OF SECTION

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SECTION 23 82 40

WALL UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall unit heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

A. **Product Data.** For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. **Shop Drawings.**

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details of anchorages and attachments to structure and to supported equipment.
4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
5. Wiring Diagrams: Power, signal, and control wiring.

C. **Samples.** For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. **Operation and maintenance data.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Manufacturers.** Subject to compliance with requirements, provide products by one of the following:

1. Berko; Marley Engineered Products.
2. Chromalox, Inc.
3. Indeeco (Basis of Design).
4. Markel Products Company; TPI Corporation.
5. Marley Engineered Products.

6. QMark; Marley Engineered Products.

2.2 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. **Electrical Components, Devices, and Accessories.** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. **Front Panel.** Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.

B. **Finish.** Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. **Surface-Mounted Cabinet Enclosure.** Steel with finish to match cabinet.

2.4 ELEMENTS

A. **Corrosion resistant steel tubular elements with brazed steel fins.** Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

2.5 FAN AND MOTOR

A. **Fan.** Aluminum propeller directly connected to motor.

B. **Motor.** Permanently lubricated. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. **Controls.** Unit-mounted tamperproof thermostat.

B. **Electrical Connection.** Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall unit heaters level and plumb.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION

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SECTION 23 83 24

ELECTRIC BASEBOARD HEATERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric baseboard heaters.

1.2 SUBMITTALS

A. Submittals are required and shall include product data noting capacities at the specified conditions, materials, sizes, and dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Markel
B. Indeeco (Basis of Design)
C. Qmark.
D. Berko

2.2 HIGH WATT DENSITY DRAFT BARRIER HEATERS (INDEECO BHI)

A. Housing: Minimum 18 gage steel with 14 gage aluminum front and top covers, finished with an epoxy/polyester powder paint finish, with end caps. Units to have legs/pedestals. Standard color per Architect.

B. **Heating Element:** Two stainless steel elements with aluminum fins floating on high temperature nylon bushings for quiet operation.

C. **Grilles:** Intake on bottom of units with top outlet grilles with openings less than 0.25" wide to discourage tampering (pencil-proof).

D. **Built-In Controls:** Linear limit, auto reset thermal cutout.

E. **Electrical connection:** Prewired junction boxes located at right ends of units, with a full length wireway.

F. Provide with wall or unit mounted thermostat as shown, noted, or scheduled, and integral disconnect.

2.3 INDUSTRIAL SILL HEIGHT CONVECTOR/BASEBOARD HEATERS (INDEECO BII (FLAT TOP)/BISI(SLOPE TOP))

A. Housing: Minimum 18 gage steel with minimum 16 gage steel front cover, with enclosure and all steel hardware completely finished with an epoxy/polyester powder paint finish, with end caps or wall-to-wall as shown. Standard color per Architect.

B. **Heating Element:** Stainless steel elements with aluminum fins floating on high temperature nylon bushings for quiet operation.

C. **Grilles:** Intake on front of units with top outlet grilles with openings less than 0.25" wide to discourage tampering (pencil-proof).

D. **Internal Controls:** Linear limit, auto reset thermal cutout.

E. **Electrical Connection:** Prewired junction boxes located at units as required, with a full length wireway.

F. **Other:** Provide with other features as shown, noted, or scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturers requirements.

END OF SECTION

SECTION 23 84 16

DEHUMIDIFIERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. **Submittal Package.** Manufacturer shall provide digital copy (pdf) of clearly legible and bookmarked project specific documents containing only information specific to the project application for approval by the Owners Representative prior to final design and manufacture. As a minimum, the submittal package shall include the following: (note: generic/standard drawings and/or forms are not acceptable):

1. Project specific drawings defined as documents containing only information specific to this application.

2. Dimensioned views of the equipment with clearance and service access areas required for all system components clearly defined, including:

    a. Plan view
    b. Side elevation
    c. System weight as proposed including all unit-mounted and remote-mounted components required to meet these specifications.

3. Electrical schematic wiring drawing including:

    a. Utility requirements
    b. Identification of items requiring field connection

4. Other drawings as required:

    a. Chilled water piping schematic
    b. System flow diagram

B. **Operating & Maintenance Manual.** Manufacturer shall provide a maximum of 1 copy and 2 CD of the operating and maintenance manual for the proposed equipment. As a minimum, the manual shall contain:

1. Installation guidelines
2. Start-up checklist
3. Troubleshooting guide.
4. Sequence of operations.
5. Required maintenance activities and their recommended frequency
6. A list of recommended spare parts
7. 24-hour, 7-day service assistance telephone number
8. Material Safety Data Sheet for the desiccant wheel
9. Manufacturer’s data for major components.

1.2 SAFETY AGENCY LISTED & CERTIFICATION

A. **Main control panel enclosure** to be manufactured and labeled in accordance with UL 508A guidelines.

B. **All coils** to be manufactured in accordance with ARI standards.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids. Inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.4 STANDARD WARRANTY

A. The manufacturer shall provide a warranty during the first year of operation (twelve months from date of shipment). The warranty shall consist of repair or replacement of defective parts only, labor not included. The warranty does not apply to maintenance items such as but not limited to filters, belts, and seals.

B. If any defects appear under this warranty, the manufacturer will be notified, and the manufacturer shall provide appropriate replacement parts only at no cost to the owner.

C. The manufacturer shall warrant its desiccant wheel to maintain the specified adsorption capacity for a period of two years commencing from the date of shipment.

1.5 EQUIPMENT SUPPORT

A. The manufacturer shall provide support for the equipment for a minimum period of 15 years following shipment of the equipment. This support shall, as a minimum, consist of:

B. The manufacturer shall provide spare parts required for the proposed equipment for the full term of the 15-year support period, regardless of whether the equipment remains in current production.

C. The manufacturer shall ensure that qualified factory service technicians are available to assist the Owner 24 hours a day, 7 days a week

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The manufacturer of the dehumidifier shall have a minimum of 10 years of documented field operating experience and a minimum of one thousand units in the field of the specific equipment proposed

B. The manufacturer shall design, produce and service the proposed equipment in a consistent and high-quality manner.

C. Basis of Design and source for dehumidifier system: Bry-Air, Inc. Sunbury, OH.

2.2 EQUIPMENT

A. Provide complete factory assembled and tested unit of sizes, arrangements, capacities, and performance as per drawings, schedules, and specifications.

B. **Unit Construction.** The unit casing shall be constructed of 1/8" aluminum line welded and sealed as a single unified structure. Structures depending on screws for casing construction are not acceptable.

1. All air handling structures shall be insulated as required to minimize exterior sweating and heat transfer. Interior surfaces shall be covered with a rigid foil faced thermal insulation held in place by an adhesive applied to the entire securing area. Insulating material shall have a minimum thermal rating of at least R-6.5 per inch thickness determined by ASTM C518 and a water absorption rating of not more than 0.3% by ASTM Test Method C 209, and shall have an operating range of -100°F to 250°F. Unit shall be double wall, to prevent exposed insulation in the process air stream.

2. All major components such as coils, filters, blowers, etc., provided on the system shall be easily accessible without disassembling plenums or distributing ductwork. Access panels shall be provided, constructed and insulated with the same material as the dehumidification system. All access panels shall be equipped with complete, compressible, resilient, foamed elastomer gaskets with a fastening system that assures the air and vapor tight integrity of the dehumidification system. Access panels for filter replacement shall hinged and have quick release fasteners that eliminate the need to remove hardware. All other access panels shall have secure fasteners. All access panels shall be labeled.

3. Connections for ductwork shall be provided with slip joint or flanged connections.

4. All exterior surfaces shall be degreased and cleaned prior to finishing, primed with an industrial primer, followed by a continuous coat of high quality U.V. resistant exterior paint. All hard to reach pieces shall be painted prior to assembly to assure proper coating.

5. The entire system shall be provided on a welded structural base frame.

6. The dehumidifier shall be capable of continuous indoor operation. All access panels shall be vapor tight, as shall all joints between casing and

electrical conduits and between the system casing and any components mounted in separate enclosures.

7. The system shall include access panels for inspection and for any maintenance required by the operating and maintenance manual. These panels shall be fastened by secure rust resistant hardware. The system shall be airtight to the extent of not leaking more than 1% of the rated flow when the casing is under 5" WC of negative pressure. Panels without gaskets shall not be acceptable.

2.3 DESICCANT DEHUMIDIFIER

A. The desiccant wheel media shall be a monolithic, extended-surface contact medium, fabricated entirely of inert, inorganic binders and glass fibers formed into narrow passages in the direction of airflow. The wheel shall be bacteriostatic and non-toxic. It shall also meet the following requirements:

1. The glass fibers which form the support matrix shall be made from uniform continuous strands larger than five microns in diameter which are non-respirable and shall not be considered a possible health risk by the International Agency for Research on Cancer (IARC).

2. The wheel shall be tested according to ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials) and shall achieve the following results:

   a. Flame spread index = 0
   b. Smoke developed index = 10

3. The desiccant shall be evenly impregnated throughout the structure for predictable, consistent performance and for maximum wheel life.

4. The desiccant impregnated into the contact medium shall be silica gel. The desiccant wheel shall be a fabricated extended surface contact media with a multitude of small passages parallel to the airflow. The rotary structure shall be a monolithic composite consisting of inert silicates with microscopic pores designed to remove water in a vapor phase. The desiccant shall be hydro thermally-stabilized silica gel.

   a. Desiccant wheel shall be 100 to 400 mm deep in direction of air flow as per the drawings

B. **Desiccant Wheel Support and Drive Assembly.** The wheel shall be a single piece for fast removal and simple handling. The desiccant wheel shall be supported by two, 200,000 hour rated, sealed, non-maintenance type bearings, pre-loaded and pre-lubricated for high temperature environments. Rotor bearings shall be press fit to the rotor hub and the rotor shall be mounted with a removable central shaft for easy service. The rotor shaft shall be securely mounted to rigid horizontal supports inside the dehumidifier cabinet to ensure precise location of the rotor relative to the seals. Roller supports shall not be acceptable.

C. **Air Seals.** The process and reactivation air streams shall be separated by air seals and internal partitions so that the humid reactivation air does not mix with the dry process air. The proposed equipment shall meet the following minimum requirements:

1. The dehumidifier shall have full-face seals on both the process air entering and the process air leaving sides of the wheel. These shall seal the entire perimeter of both air streams as they enter and leave the wheel. Partial seals shall not be acceptable. The seals shall be silicone or viton, with a low-friction, abrasive-resistant design to extend seal life and reduce the force needed to turn the desiccant wheel. Seals shall be easily inspected and removable without the use of any tools.

D. **Airflow Gauges.** To set and verify the specified air flow rates through the unit, the casing shall be equipped with differential pressure gauges which measure and display the pressure drop across the desiccant wheel. The dial of the gauges shall be scaled to display the correct air volume in the middle of the dial.

E. **Service Access Panels.** Provide labeled and gasketed access panels at all areas requiring routine service and at internal control component locations.

2.4 ASSOCIATED AIR-COOLED CHILLER CH-1

A. The dehumidifier chiller shall be as scheduled and it shall be ETL Listed to UL1995. Other features to include:

1. Integral pumps with all required valves and specialties.
2. Single point power connection.
3. Programmable logic controller with HMI touch screen display.
4. Stainless steel tank and stainless steel brazed plate evaporator.
5. Multiple scroll compressors with crankcase heaters, suction accumulators, and hot gas bypass control.
6. Direct drive condenser fans.
7. 24v control transformer.
8. Copper tube/aluminum fin condenser coils.
9. Powder coated painted and galvanized sheet metal cabinet.
10. ½” insulation on all water and low pressure refrigerant lines.
11. Liquid line filter driers, sight glasses, solenoid valves, and TXV’s.
12. Complete factory charge of refrigerant and oil.
13. Factory performance test prior to shipment.
14. Warranty to be 12 months parts, with 4 years additional on compressors.
15. Post-cool chilled water coil with modulating 3-way control valve.
16. 115V (rain tight) service outlet (field wired).
17. Phase monitor, line voltage monitoring for phase loss/reversal, unbalance, and high/low voltage.
18. Compressor fusing.
19. Tank sight glass.
20. Heated, flooded condenser w/ receiver/head pressure control (0 deg F).
21. Dual process pump with auto-changeover.
22. Pump suction isolation valves.
23. Water pressure gage set.
24. Auto system fluid make-up solenoid and auto level switch.

PART 3 - EXECUTION

3.1 Follow equipment manufacturers written instructions for handling and installation of equipment.

3.2 All equipment shall comply with applicable local and national codes.

3.3 Included in the scope of this specification

A. Start-up and operator training to be performed by the dehumidifier manufacturer.

3.4 Not included in the scope of this specification are:

A. Furnishing of equipment and labor necessary to unload the equipment at the job site.
B. Furnishing of labor for installation.

END SECTION

SECTION 26 00 01

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 01 33 00, "Submittals."
2. Section 01 50 00, "Temporary Construction Facilities."
3. Section 01 60 00, "Materials and Equipment."
4. Section 01 79 00, "Startup, Demonstration and Training."
5. Section 01 74 23, "Cleaning."
6. Section 26 00 02, "Basic Electrical Materials and Methods."
12 Section 40 90 00, “Instrumentation System Basic Requirements”

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary to implement the following general administrative and procedural requirements in accordance with the plans and as specified herein.

B. **Extent of Work**. Work under this Contract consists of furnishing, installing, testing, and guaranteeing of complete electrical systems as shown on the drawings and as specified in Division 26. The Contractor shall connect and place all wired equipment in proper working order. Refer to the plans and specifications for work included in this Contract. Some general guidelines to coordinating work between Division 26 and Divisions 23, 40, 41, 43, 44, and 46. are as follows:

1. Division 26 includes all power wiring and raceways for Division 23 equipment. Division 26 is responsible to furnish and install motor starters and disconnect switches for Division 23 equipment. Remote two-wire control logic will be extended to the motor starters as work of Division 23. Where combined line voltage power/control is used for Division 23 equipment, the wiring and raceways are treated as power wiring and are work of Division 26. All Division 26 work for Division 23 equipment is shown on the plans.
2. Division 26 includes the installation of all conduits or other raceways with power, control, interlocking wiring between panels, and instruments supplied under the instrumentation Division 40 scope
3. Division 26 includes all 3-phase power for plant equipment provided under Divisions 40, 41, 43, 44, and 46. The instrumentation and control system as specified in Division 40 wiring and interior raceways is not work of Division 26. Exterior raceways for the instrumentation and control system are part of Division 26 work to the extent shown on the plans. Field wiring for plant equipment is work of Division 26. All

Division 26 work for Divisions 40, 41, 43, 44, and 46 equipment is shown on the plans.

4. No generalities regarding the coordination of work with the work of Divisions other than 40, 41, 43, 44, and 46. can be made. See the plans for the extent of these requirements for Division 26 work.

C. **Temporary Utilities.** Temporary utilities and connections include the following:

1. Engage the local utility company for temporary electric service.
2. Temporary telephones for the Engineer/Architect's field office.
3. Temporary lighting to provide adequate illumination of work areas and security.
4. Temporary power and connections to maintain existing equipment in operation and to permit operation of new equipment as construction progresses.
5. Temporary overhead secondary service to buildings and equipment as shown on the drawings.
6. The monthly construction power cost shall be shared by each Contractor in proportion to use. The contractor shall be responsible for providing temporary power and associated equipment for continuous and full operation of the wastewater treatment facility during construction.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. All work shall be installed in full accordance with the latest edition of the National Electrical Code (NEC) as prepared and published by the National Fire Protection Association (NFPA) and any applicable local or state codes. All electrical equipment shall be listed and labeled by Underwriters' Laboratories, Inc. (UL) or any approved independent nationally recognized electrical testing laboratory where such standards exist. Optionally, in lieu of such listing and labeling, equipment preapproved by the Electrical Inspector may be supplied. Wherever UL compliance is mentioned in the specifications, the above alternatives shall be understood to apply to all listing and labeling requirements. This does not preempt or replace the specifications or replace the approval process. All service switches/circuit breakers shall be labeled as outlined above for service entrance duty.

2. Comply with the requirements of NFPA Code 241 "Standards for Safeguarding Construction, Alteration, and Demolition Operations," the American National Standards Institute (ANSI) A10 Series standards for "Safety Requirements for Construction and Demolition," and the National Electrical Contractors Association (NECA) National Joint Guideline NJG-6 "Temporary Job Utilities and Services."

B. **Permits and Regulations.** The Contractor shall obtain all permits and inspections required by laws, ordinances, rules, regulations, and public authority having jurisdiction and shall obtain certificates of such inspections and shall submit same to the Engineer/Architect and shall pay all fees, charges, and expenses in connection therewith. The Contractor shall furnish to the Owner a

certificate of final inspection from the proper authority prior to final payment. Obtain and pay for easements required to bring temporary utilities to the site, where the Owner's easement cannot be utilized for that purpose.

1.4 SUBMITTALS

A. **General.** Follow the procedures specified in Section 01 33 00, "Submittals," and in addition, the Contractor shall prepare and submit a complete submittal list to the Engineer. The submittal list shall include all submittal items covered in the Division 26 specification sections. In addition, the submittal list shall contain dates for all items to be submitted and shall accompany the first submittal. The submittal list shall be coordinated with the construction schedule and shall clearly show such coordination.

B. **Shop Drawings.** Shop drawings shall be submitted to the Engineer for review for compliance with the Contract Documents. Shop drawings shall identify the specific equipment and material being supplied; the location on the project where it is to be used; the quantity being supplied; and all accessories, dimensions, descriptions, mounting and connection details, wiring diagrams, elementary control diagrams, equipment interface diagrams, and any other information necessary to determine compliance with the plans and specifications. Typical shop drawing review will require 10 working days following receipt of all information necessary to determine compliance with the plans and specifications. If the submittal schedule or actual submittal contains too large a quantity to allow a 10-day turnaround, the Contractor will be so informed as early as possible. The added number of days required for review will be determined at that time. Fabrication and installation shall be in accordance with the approved shop drawings. Products submitted as substitutions shall be clearly marked as such in the submittal. Please see general and supplemental conditions for further requirements for substitutions.

1. Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for distribution plus two copies of each submittal which will be retained by the Engineer/Architect.

    a. Shop Drawings - Initial Submittal. One additional blue or black line print.
    b. Shop Drawings - Final Submittal. One additional blue or black line print.
    c. Product Data. One additional copy of each item.
    d. Samples. One additional for each item.

    Additional copies may be required by individual sections of these specifications.

C. **Permits and Easements.** Submit copies of reports, permits, and easements necessary for installation, use, and operation.

D. **Test Reports.** Submit copies of reports of tests, inspections, and meter readings as specified. Tests, inspections, and meter readings shall be performed using the Contractor's temporary power source unless otherwise specified.

E. **Coordination Drawings**

1. Prepare and submit prior to commencing such work coordination drawings in accordance with Division 1 section "Project Coordination" to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

    a. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

        1) Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
        2) Exterior wall and foundation penetrations.
        3) Fire rated wall and floor penetrations.
        4) Equipment connections and support details. Demonstrate evidence of dimensional coordination.
        5) Sizes and location of concrete pads and bases.

    b. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

    c. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

    d. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling mounted devices.

F. **Record Documents**

1. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate installed conditions for:

    a. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
    b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
    c. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

2. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located to record the locations and invert elevations of underground installations.

G. **Operation and Maintenance Manuals**

1. Prepare maintenance manuals in accordance with Division 1. Compile and assemble the operation and maintenance data of equipment specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference. Data shall clearly indicate only provided options and accessories.

2. In addition to the requirements specified in Division 1, include the following information for equipment items:

   a. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
   b. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   c. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
   d. Servicing instructions and lubrication charts and schedules.
   e. Spare parts list as required by individual Division 26 sections.

1.5 JOB CONDITIONS

A. **Coordination.** Coordinate with other trades to prevent delays, omissions, or errors.

B. **Scheduling.** It is mandatory that the facility be maintained in operation during construction and that periods of shutdown due to "line changeovers," etc., are held to a minimum. These outages must be scheduled with and have the concurrence of the Engineer/Architect and the Owner. Further, it is mandatory that the completion of various stages of the electrical work coincide with the other phases of construction to maintain present and permit operation of new installations as construction progresses.

C. **Controls and Wiring.** Controls and wiring shall be furnished and installed as specified under the electrical contract based on the ratings and horsepowers shown on the plans. The general, heating, ventilating, and air conditioning (HVAC), and plumbing contractors shall verify the rating and horsepower of the equipment they propose to furnish and shall provide for any necessary electrical changes to accommodate the equipment furnished at no change in contract price.

D. **Controls and Wiring.** The Contractor shall verify the rating and the horsepower of the equipment he proposes to furnish and shall provide for any necessary electrical changes to accommodate the equipment furnished at no change in contract price.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery.** Deliver products to the project identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 SPECIAL WARRANTY

A. **General.** Compile and assemble the warranties specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.

1. Provide complete warranty information for each item. Information to include:

a. Product or equipment list.
b. Date of beginning of warranty or bond.
c. Duration of warranty or bond.
d. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.8 DEFINITIONS

A. **Finished Areas.** In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.

B. **Interior.** For the purposes of this specification, interior is any area within the boundaries of the foundation of any building or within the superstructure of other structures not classified as a building.

C. **Hazardous (Classified) Areas.** Hazardous (classified) areas are designated on the drawings in conformance with the NEC. All equipment and the installation shall conform to requirements for installation in the designated hazardous area as described in Articles 500, 501, 502, and 504 of the NEC.

1.9 FAULT CURRENT, COORDINATION, AND SELECTIVITY STUDY

A. **General.** The Contractor shall provide to the Engineer three copies of a written, detailed, documented selective power distribution system report showing fault currents available using log-log graphical representation. The report shall be stamped by a Registered Professional Electrical Engineer. The report shall be based upon data compiled by the Contractor from the actual equipment installed. The report must be submitted and reviewed for compliance prior to project closeout. As a minimum, the report shall contain the following:

1. Overall system description and diagrams.

2. System selectivity under fault and other overload conditions.

3. Ground fault system operation and selectivity.

4. Tabularized ratings and settings of protection devices verified by electrical testing to ensure coordination and selectivity.

a. Momentary and interrupting ratings.
b. Relays and shunt trip devices.

c. Fuses.
d. Circuit breakers.

5. Calculated fault currents shall be provided for at least one feeder/branch circuit from each motor control center and between each switchboard, switchgear, and motor control center.

6. Equipment and conductor damage curves.

7. Pick up and time current characteristics.

8. Short circuit data.

9. Detailed description of test procedures.

10. Design calculations.

11. Description of compatibility with the existing system.

12. Refer to section 26 05 73 for complete requirements.

PART 2 - PRODUCTS

Not used.

2.1 TEMPORARY ELECTRICAL EQUIPMENT

A. **General.** Provide new materials and equipment for temporary services and facilities; if acceptable to the Engineer, used materials and equipment that are undamaged may be used. Provide materials and equipment that are suitable for the intended use.

1. Provide weathertight, grounded temporary electrical distribution system, with ground fault circuit interrupters and ground fault interrupter features of proper types, sizes, electrical ratings, and characteristics to fulfill project requirements. Provide overcurrent protective devices at main distribution panel for power and light circuitry. Provide disconnects for equipment circuits.
2. Provide circuits of proper sizes, characteristics, and ratings for each use indicated. Provide rigid steel conduit to protect wiring on grade, floors, decks, or other areas exposed to possible damage. Provide 20 ampere, four gang receptacle outlets, equipped with ground fault circuit interrupters, reset button and pilot light, spaced so that a 100 foot extension cord can reach each area of work. Use only grounded extension cords; use "hard service" cords where exposed to abrasion and traffic. Provide warning signs at power outlets that are other than 120 volt. Provide outlets of proper National Electrical Manufacturers Association (NEMA) configuration to prevent insertion of 120 volt plugs into higher voltage outlets.
3. Provide general service LED lamps of wattage required for adequate illumination. Protect lamps with guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior type fixtures where exposed to weather or moisture. Provide local switching to allow lights to be turned off in patterns to conserve energy.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **General.** Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

3.2 PREPARATION

A. **Rough-In**

1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
2. Refer to equipment specifications specified elsewhere for rough-in requirements.

B. **Coordination**

1. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete or supported from or on other structural components, as they are constructed.
2. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service and place each in proper operating order.
3. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building and equipment which must be placed in service before further construction can take place.

C. **Clearance.** Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

3.3 INSTALLATION

A. **General.** Install systems, materials, and equipment to conform with submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer/Architect before final placement.

1. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

2. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

3. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 8.

4. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. **Temporary Electric.** The Contractor shall furnish, install, maintain, and remove the temporary electrical power and lighting systems, including temporary service equipment, wiring, portable generator sets, etc. as shown on the drawings and specified herein and pay for all labor, materials, and equipment as required to maintain full operation of the facilities during construction.

The Contractor shall make all necessary arrangements with the local utility company as to where the temporary electric service can be obtained

The Contractor shall secure and pay for all required permits and back charges for work performed by others, and other expenses incidental to the installation of the temporary electric service.

The Contractor shall be responsible to pay for temporary generator sets including the required fuel.

All such temporary electrical work shall meet the requirements of the National Electrical Code, the local utility company, and OSHA. Locate temporary services and facilities where they will serve the project adequately and result in minimum interference with the work. Connect the service to the local utility company's temporary power source in the manner directed by the utility company officials. Install temporary lighting to fulfill security and protection requirements, without having to operate the entire temporary lighting system. Inspect and test the temporary electric service before placing in use. Arrange for inspections and test and obtain permits for use. Provide temporary electrical connections when first needed to avoid delay in the work. Maintain, expand, and modify temporary connections as needed. Remove temporary electrical service and connections promptly when need has ended, or when replaced by use of a permanent facility. Complete, or if necessary, restore permanent work delayed because of interference with the temporary service or facility. Repair damaged work, clean exposed surfaces, and replace work which cannot be repaired. At substantial completion, clean and renovate permanent services and facilities that have been used to provide temporary services and facilities during the construction period.

3.4 CUTTING AND PATCHING

A. **General**. Perform cutting and patching in accordance with the General Conditions and the following requirements:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:

a. Uncover work to provide for installation of ill-timed work.
b. Remove and replace defective work.
c. Remove and replace work not conforming to requirements of the Contract Documents.
d. Remove samples of installed work as specified for testing.
e. Install equipment and materials in existing structures.
f. Upon written instructions from the Engineer/Architect, uncover and restore work to provide for the Engineer/Architect observation of concealed work.

2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new work. Existing electrical items not indicated to be reused are to be removed.

3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

5. Patch new or existing finished surfaces or building components which are disturbed by electrical installations. Use new matching materials.

B. **Openings, Penetrations, and Inserts**. Provide all openings required for the work. Make penetrations through walls and floors by core drilling. Seal openings after the installation of raceways, wire, or cable as specified in Section 26 05 29.

1. Core drill with the required size drill. Visually inspect the opposite side of the wall or the floor prior to drilling to verify that utilities and other in-place items will not be damaged by drilling operations. Rope off areas on the floor below the drilling location and post required warning signs.
2. Drilled penetrations shall be of adequate size to permit installation of seals in the space between penetrating items and core sides, and the spaces between penetrating items.
3. All chases, sleeves, inserts for hangers, supports, and fastenings should be located in advance of new construction in order to minimize interferences.

3.5 ELECTRICAL DEMOLITION

A. **Existing Conduit Location**

1. In existing structures at this project, there is electrical conduit embedded in concrete. It shall be the responsibility of the Contractor, under this section, to attempt to locate and mark the existence of any conduit embedded in areas where, as part of this Contract, the concrete is to be drilled or cut into for any purpose.
2. Contractor shall use every available means possible to attempt to locate existing conduit. Whenever a hole is to be cut into an existing slab, wall,

or other structural concrete, that area shall be X-rayed prior to drilling to show the locations of conduits and resteel.

B. **Removal and Relocation of Existing Electrical Apparatus**

1. The Contractor, under this section, shall remove and store or relocate all existing electrical apparatus as shown on the drawings, as specified herein, or as necessary for the completion of this Contract except where specifically called for to be included under another section of the Contract. The Contractor shall be responsible for verifying existing conditions, dimensions, locations, quantities, etc., associated with the removal and relocation of electrical apparatus. In addition, the Contractor shall be responsible for verifying and identifying the existing circuits associated with the removal and relocation of electrical apparatus. Failure of the Contractor to review the Contract Documents and verify the existing conditions shall not be sufficient cause to warrant a change in contract after contract award.

2. Where existing electrical equipment, including lighting fixtures, is shown to be removed, the Contractor shall also remove the existing branch wiring.

    a. Wiring removal shall extend to the branch disconnect or to the next piece of utilization equipment.
    b. Where new or existing equipment is to be reinstalled, the wiring shall be temporarily terminated.

3. Where part of the existing equipment on a branch circuit is to be disconnected, the circuit shall be de-energized only long enough to disconnect the equipment and terminate the wiring that is to remain.

4. All equipment and major lengths of wiring retired and removed shall remain the property of the Owner unless shown or directed otherwise and shall be placed in storage on the site by the Contractor where ordered.

5. When pumps, motors, or other apparatus are being removed under other sections of this Contract, all electrical wiring, conduit, boxes, and related equipment shall be completely removed under Division 26.

6. Removal of all equipment shall include the removal of all accessories incidental to the major units. Where wiring is removed from conduit and boxes, the accessible conduit and boxes shall also be removed.

7. When the Contract is complete, no piece of electrical equipment shall remain installed that is not in service unless otherwise ordered.

8. Where electrical conduit, boxes, or appurtenances are embedded in walls or slabs, and wires, wiring devices, fixtures, or other apparatus is removed from these embedded items, the conduits shall be cut off flush with the surface and plugged with masonry to a smooth surface and the boxes and other appurtenances covered with suitable approved stainless steel cover plates. The cover plates shall have stainless steel fasteners.

9. Electrical equipment or components, supported by materials or equipment being removed under this or other Divisions in this Contract, shall be temporarily supported during the demolition process and then properly and permanently resupported prior to the conclusion of this Contract. All supports shall meet all the applicable requirements of this Division.

10. Any electrical equipment or components damaged during the performance of this Contract shall be replaced or repaired to a "like new" condition in accordance with the requirements of this Division.

3.6 CLEANING

A. **General**. When all work is completed and has been tested and accepted by the Engineer/Architect, the Contractor shall clean all light fixtures, equipment, and exposed surfaces that have been directly affected by this work. The Contractor, insofar as the work is concerned, shall at all times keep the premises in a neat and orderly condition and at the completion of the work shall properly clean up and remove from the site any excess materials.

3.7 DEMONSTRATION

A. **General**. The Contractor shall perform a 14-day operational demonstration of the complete electrical system. The 14-day operational demonstration shall not begin until all field tests are completed and all problems and defects encountered during the field test have been corrected.

B. **System Acceptance.** System acceptance beyond the level of Substantial Completion shall not occur until the entire electrical system has performed as a functioning unit continuously for 30 consecutive days. Failure of any component or required feature shall require a restart of the 14-day operational demonstration until 30 consecutive days of continuous operation have been completed.

C. **Staffing**. Provide the services of qualified service technician for the duration of the 14-day operational demonstration.

END OF SECTION

SECTION 26 00 02

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Section 02 41 00, "Demolition."
2. Section 31 23 34, "Excavation, Backfill, and Embankment."
3. Section 03 30 00, "Cast-in-Place Concrete."
4. Section 26 00 01, "Basic Electrical Requirements."

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to provide basic electrical materials in accordance with the plans and as specified herein.

B. **Applications.** This section includes limited scope general construction materials and methods for application with electrical installations as follows:

1. Excavation for underground utilities and services, including underground raceways, vaults, and equipment.
2. Miscellaneous metals for support of electrical materials and equipment.
3. Wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.
4. Concrete used for outdoor equipment pads, pole base foundations, pipe supports, and housekeeping pads for all floor-mounted equipment including but not limited to motor control centers, switchboards, and transformers, and freestanding motor controllers, switches, circuit breakers, and custom panels.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with basic electrical materials in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein. Where provisions of the pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings."
2. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
3. National Electrical Code (NEC).

B. **Qualifications**

1. Installer Qualifications. Engage an experienced installer for the installation.

2. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

a. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.4 **SUBMITTALS**

A. **Shop Drawings.** Shop drawings detailing fabrication and installation for metal fabrications and wood supports, and anchorage for electrical materials and equipment.

B. **Certificates.** Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this section.

1.5 **JOB CONDITIONS**

A. **Coordination.** Coordinate with other trades to prevent delays, omissions, or errors.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Storage and Handling.** Store and handle materials in compliance with the manufacturer's recommendations to prevent their deterioration and damage.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Miscellaneous Metals and Reinforcing Materials**

1. Provide steel plates, shapes, bars, and bar grating conforming to American Society for Testing and Materials (ASTM) A 36.
2. Provide cold formed steel tubing conforming to ASTM A 500.
3. Provide hot rolled steel tubing conforming to ASTM A 501.
4. Provide steel pipe conforming to ASTM A 53, Schedule 40, welded.
5. Provide nonshrink, nonmetallic grout which is premixed, factory packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.
6. Provide fasteners which are zinc-coated, type, grade, and class as required.
7. Provide deformed reinforcing bars conforming to ASTM A 615, Grade 40 or 60, unless otherwise indicated.

8. Provide reinforcing materials with size and placement as shown on the plans.
9. Provide welded wire fabric conforming to ASTM A 185.

B. **Miscellaneous Lumber**

1. Provide framing materials which are Standard Grade, light framing size lumber of any species. Number 3 Common or Standard Grade boards complying with West Coast Lumber Inspection Bureau (WCLIB) or American Wood Preservers Association (AWPA) rules, or Number 3 boards complying with Southern Pine Inspection Bureau (SPIB) rules. Lumber shall be preservative treated in accordance with AWPA LP-2 and kiln dried to a moisture content of not more than 19 percent.
2. Provide construction panels which are plywood panels; American Plywood Association (APA) C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inch.

C. **Concrete**

1. Provide concrete as specified in Section 03 30 00, "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 EXAMINATION

A. **General.** Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

1. Field-verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and regulations, the Contract Documents, and the referenced standards.
2. The work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.
3. In the event any discrepancies are discovered, immediately notify the Engineer/Architect in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 EXCAVATION

A. **General.** Perform excavation in accordance with Section 31 23 34, "Excavation and Backfill," and in accordance with any local codes and ordinances.

3.3 ERECTION

A. **Erection of Metal Supports and Anchorage**

1. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
2. Provide field welding which complies with AWS "Structural Welding Code."

B. **Erection of Wood Supports and Anchorage**

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
2. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

3.4 INSTALLATION

A. **Concrete**. Install concrete in accordance with Section 03 30 00, "Cast-in-Place Concrete," and in accordance with the plans and as specified herein.

1. Strength, Spacing, and Placement of Equipment Housekeeping Pads. Provide a housekeeping pad for all floor mounted equipment unless noted otherwise. Fabricate pad as follows:

    a. Coordinate size of housekeeping pad with actual equipment provided. Fabricate base 4 inches larger in both directions than the overall dimensions of the supported equipment.
    b. Form concrete pads with framing lumber with form release compounds. Provide 1-inch chamfer on top edge and corners of pad.
    c. Install reinforcing bars and place anchor bolts and sleeves to facilitate securing equipment.

END OF SECTION

SECTION 26 05 12

WIRE, CABLES, AND CONNECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 23, "Communication and Signal Cables."
4. Section 26 05 34, "Cabinets, Boxes, and Fittings."

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install wires, cables, and connectors in accordance with the plans and as specified herein.

B. **Miscellaneous.** This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with wires, cables, and connectors in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Fire Protection Association (NFPA) 70, "National Electrical Code (NEC)."
2. Underwriters' Laboratories, Inc. (UL) Compliance. Provide components which are listed and labeled by UL under the following standards.

a.	UL Standard 83	Thermoplastic Insulated Wires and Cables.
b.	UL Standard 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors.
c.	UL Standard 854	Service Entrance Cable.

3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA) Compliance. Provide components which comply with the following standards:
   a. WC-70 Nonshielded 0-2 kV Cables.

4. Institute of Electrical and Electronics Engineers (IEEE) Compliance. Provide components which comply with the following standards:

a. Standard 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors.

1.4 **SUBMITTALS**

A. **General.** Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Submittals.** Submit the following in accordance with Conditions of Contract and Division 1 specification sections:

1. Product data for electrical wires, cables, and connectors.
2. Product data for Megger insulation testing instrument.
3. Report sheets for Megger testing.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Deliver wire and cable properly packaged** in factory-fabricated-type containers, or wound on NEMA specified type wire and cable reels.

B. **Store wire and cable in clean dry space** in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

C. **Handle wire and cable carefully** to avoid abrading, puncturing, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Wires and Cables**

1. Provide electrical wires and cables of manufacturer's standard materials as indicated by published product information designed and constructed as recommended by manufacturer for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98 percent at 20 degrees Celsius (° C.) (68 degrees Fahrenheit [° F.]).

2. Provide factory fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, and NEC and NEMA standards. Select from the following UL types those wires with construction features which fulfill project requirements:

a. Provide Type RHW-2 for dry and wet locations, temperature rating 90° C. (194° F.). Insulation, flame-retardant, moisture-resistant thermoset; conductor, annealed copper.
b. Provide Type XHHW-2 for dry and wet locations, temperature rating 90° C. (194° F.). Insulation, flame-retardant, moisture-resistant thermoset; conductor, annealed copper.
c. Provide Type THWN-2 for dry and wet locations; temperature rating 90° C. (194° F.). Insulation, moisture- and heat-resistant, flame-retardant thermoplastic; conductor, annealed copper.
d. Provide Type USE-2 for dry and wet locations; temperature rating 90° C. (194° F.). Insulation, moisture and heat resistant; conductor annealed copper.

3. Provide color coding for phase identification in accordance with requirements in Section 26 05 53, "Electrical Identification."

   a. Wiring and identification for emergency systems shall be in compliance with NEC Article 700-9.

4. Conductor stranding shall be as follows:

AWG kcmil	Strands (RHW/THW)	Strands (XHHW)	Strands (THWN/THHN)
No. 14 to No. 10	1	7	1
No. 8 to No. 2	7	7	19
No. 1 to No. 4/0	19	19	19
250 to 500	37	37	37
600 and above	61	61	61

B. **Variable-Frequency Drive (VFD) Cables**

1. Material. Conductors shall be annealed copper, conforming to American Society for Testing and Materials (ASTM) B 3 and B 8 and have cross-linked polyethylene (XLPE) insulation, meeting the requirements of UL Standard 44, suitable for use in wet and dry locations at a conductor temperature not exceeding 90° C.
2. Conductor insulation thickness shall be at least 0.045 inches for No. 12 and No. 10 AWG conductors and 0.060 inches for No. 8 through No. 2 AWG conductors.
3. Ground conductors shall be cabled with either one full-size insulated conductor or three bare conductors. Where three conductors are used, the sum of the cross sectional areas of the ground conductors shall be equal to, or greater than, that of an equipment ground conductor sized according to NEC Table 250.122 for the overcurrent device as shown on the contract drawings protecting the VFD cable.
4. Conductors shall be provided with either an overall aluminum foil 100 percent shield covered by a tinned copper braid shield or a 5-mil-thick copper tape corrugated and longitudinally applied with a minimum overlap of 15 percent to form a 100 percent shield.
5. The cable shall be provided with an overall polyvinyl chloride (PVC) jacket, UL 1277 listed as Type TC, Tray Cable.

C. **Connectors and Terminals**

1. General. Provide UL-type factory-fabricated metal connectors and terminals of sizes, ampacity ratings, materials, types, and classes indicated.
2. Twist-on Connectors. Conforming to UL 486 C consisting of a tapered spring with insulated outer covering.
3. Compression Connectors. Tin plated copper. Configuration shall be tee, in-line, etc., as required.
4. Terminals. Tin plated copper, compression locking fork tongue with insulated barrel.
5. Compression Lugs. Tin-plated copper, standard barrel, one hole or two hole as required.
6. Pin Terminators. Tin plated copper, compression, for wire sizes No. 18 American Wire Gauge (AWG) to No. 8 AWG.
7. Heat-Shrink Insulation. Heat-shrinkable polyolefin with an internally applied adhesive watertight sealant.
8. Motor Connection Kit. Consisting of compression lugs bolted together, cloth tape cover, and heat shrink insulation.
9. Splice Kit. Consisting of compression connector and heat-shrink insulation.

2.2 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Wire and Cable.

    a. Southwire Company.
    b. General Cable Co
    c. Rome Cable Corp.
    d. American Insulated Wire Corp.

2. VFD Cable.

    a. Belden.
    b. Tamaqua Cable Products Corp.
    c. Or equal.

3. Connectors and Terminals for Wires and Cable Conductors.

    a. AMP.
    b. Burndy Corporation.
    c. Grafoplast Wiremarkers, Inc.
    d. Ideal Industries, Inc.
    e. 3M Company
    f. O-Z/Gedney Co.
    g. Raychem.
    h. Square D Company.
    i. Thomas and Betts Corp.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION

A. **Uses Permitted**

1. Install UL-Type RHW-2 cable in conduit for service entrance and distribution power feeders from service entrance switchboard to Motor Control Centers and main distribution panels. Cable shall be rated for cable tray use where applicable.
2. Install UL-Type THWN-2 cable in conduit, for branch circuits, for panel-board feeder circuits, motor branch circuits, lighting, receptacles, and interior control and metering circuits.
3. Install VFD cables between VFDs and motors.
4. UL-Type MTW cable acceptable for use in control panels.

B. **Install electrical cables**, wires, and connectors in compliance with NEC.

C. **Coordinate cable installation** with other work.

D. **Pull conductors simultaneously** where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

E. **Use pulling means** including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

F. **Conceal all cable** in finished spaces.

G. **Install exposed cable** parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

H. **Power conductors shall be** No. 12 AWG minimum. Control conductors may be No. 14 AWG where circuit amperes and the NEC allow and when length does not pose a voltage drop problem.

I. **Conductors shall be sized** such that voltage drop does not exceed 3 percent for branch circuits or 5 percent for feeder/branch circuit combination.

J. **Provide adequate length of conductors** within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

K. **Install a maximum of three lighting circuits** or three 20-ampere, 120-volt general-use receptacle circuits per conduit. Install all other branch circuits and feeders in separate conduits unless otherwise noted.

L. **Provide a separate neutral** for every branch circuit.

3.2 CONNECTOR, TERMINAL, AND SPLICE INSTALLATION

A. **Uses Permitted**

1. Install twist-on connectors for lighting, communication, and receptacle branch circuits and utilization equipment only in size No. 8 AWG and smaller and only in finished areas.
2. Install fork tongue terminals on control and metering conductors which connect to terminal blocks.

3. Install motor connection kits on all polyphase induction motors.
4. Install compression connectors and lugs for all other connections.

B. **Service entrance conductors and feeders shall** be installed without splices. Electrical equipment feeders shall be spliced only where shown or specifically approved. Splices in electrical manholes or handholes shall not be allowed. Control and metering conductors shall be installed without splices.

C. **Install all compression connectors**, splices, and lugs with a racheting tool which will not release until proper compression is achieved.

D. **Splices where permitted** shall possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced. Use splice and tap connectors which are compatible with conductor material.

E. **Tighten electrical connectors** and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.3 FIELD QUALITY CONTROL

A. **The Contractor shall test** each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.

B. **The Contractor shall test** by Megger test, the insulation resistance between phases and from each phase to ground for each of the following feeder and motor branch circuits:

1. Motor control centers.
2. Panelboards.
3. Switchboards.
4. Switchgear.
5. Motors.

C. **Measure the insulation resistance** at 500 volts direct current (dc) with a hand cranked or motor driven "Megger" insulation testing instrument. Battery operated test instruments are not permitted. All test instruments are to be provided by the Contractor.

D. **If any insulation resistance measures** less than 50 megohms, the cable shall be considered faulty with the cable failing the insulation test. In moist environments, bag the ends of the cable to prevent a faulty Megger test.

E. **Any cable which fails** the insulation tests or which fails when tested under full load conditions shall be replaced with new cable for the full length and retested. Corrective action and repeated tests shall be accomplished at the Contractor's own expense.

F. **Maintain testing report sheets** identifying each cable tested, what each feeder or motor branch circuit will be connected to, and the level of insulation resistance measured. Test reports shall be signed by the tester, initialized by the Engineer and sent to the Engineer within 48 hours.

G. **Every belowgrade service or feeder splice shall** be water-immersion Megger tested. Each splice shall be immersed in a grounded water immersion bath for 24 continuous hours prior to and during the test. Criteria for failure shall be as described for cable above.

END OF SECTION

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SECTION 26 05 13

MEDIUM VOLTAGE POWER CABLE

PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, and materials necessary to furnish and install medium voltage electrical power cable in accordance with the plans and as specified herein.

1. Extent of electrical power cable work is indicated by drawings and schedules.

2. Types of electrical power cable and connectors specified in this section include the following:

a. Single Conductor Cable.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Electrical Power Cables**

1. Manufacturers. Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and rating required, whose products have been in satisfactory use in similar service for not less than 5 years.
2. Installer's Qualifications. Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.
3. National Electrical Code (NEC) Compliance. Comply with NEC Article 326 and 318 for tray cable requirements as applicable to construction, installation, and color coding of electrical power cables.
4. Underwriters' Laboratories, Inc. (UL) Compliance. Comply with applicable requirements of UL Standard 83, "Thermoplastic Insulated Wires and Cables," and shall be listed by UL as Type MV-90.

5. Insulated Cable Engineers Association, Inc. (ICEA) Compliance. Comply with physical and electrical requirements of ICEA Standard S-66-524 for a filled insulation.
6. Association of Edison Illuminating Companies (AEIC) Compliance. Shall meet or exceed the qualification test requirements of AEIC CS-5 and AEIC CS-6.
7. Institute of Electrical and Electronic Engineers (IEEE) Compliance. Fully comply with testing provisions of IEEE Standard 323-1974 and 383-1974 for insulation thickness and color coding.

C. **Electrical Power Cable Connections**

1. NEC Compliance. Connections, terminals, and splices shall comply with applicable provisions of NEC Article 110 through 114 and shall be UL listed and labeled.
2. Electrical Testing Laboratories, Inc. (ETL) Compliance. Connections, terminals, and splices shall be ETL listed and labeled.
3. National Electrical Manufacturers Association (NEMA)/ICEA Compliance. (WC7/5-66-524 Cross Linked Thermosetting Polyethylene to 35 kV) insulated wire and cable for the transmission and distribution of electrical energy.
4. American Society for Testing and Materials (ASTM) Compliance. Comply with applicable requirements of ASTM D 1248, Type 1, Class B, Category 5, Grades 84 and 85 for copper electrical wire.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Product Data**. Submit manufacturer's data on electrical power cables and connectors.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** power cables properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.

B. **Store** power cables in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

C. **Handle** power cable carefully to avoid abrading, puncturing, and tearing cable insulation and sheathing. Ensure that dielectric resistance integrity power/cables is maintained.

1.7 SPECIAL WARRANTY

Not used.

PART 2- PRODUCTS

2.1 MATERIALS

A. Manufacturers

1. Manufacturers. Subject to compliance with requirements, provide medium voltage power cables and connectors of one of the following (for each type of wire, cable, and connector):

    a. Wire and Cable (5KV).

        1) Aetna Insulated Wire Company.
        2) American Insulated Wire Corp.
        3) American Wire and Cable Company (to 15 kV).
        4) Brand-Rex Division, Pyle National Company (to 15 kV).
        5) Cerro Wire and Cable Corporation.
        6) General Cable Corporation.
        7) Helix Wire Corporation.
        8) Okonite Company.
        9) Phelps Dodge Cable and Wire Company.
        10) Pirelli Cable Corporation.
        11) Radix Wire Company.
        12) Rome Cable Corporation.
        13) Triangle PWC, Incorporated.
        14) Hendrix

    b. Connectors.

        1) AMP, Incorporated.
        2) Burndy Corporation.
        3) Brand-Rex Division, Pyle National Company.
        4) Electrical Products Division, Midland-Ross Corporation.
        5) General Electric Company.
        6) Ideal Industries, Incorporated.
        7) 3M Company.
        8) O-Z/Gedney Company.
        9) Thomas and Betts Corporation.

B. Power Cables and Connectors (5KV)

1. Provide electrical power cables and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with maximum resistance values based upon ASTM Specification B3 for annealed copper. Resistivity to be 891.58 pound/mile-ohm with the equivalent IACS percent conductivity of 98.16.

2. Provide UL type factory fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements, NEC, and NEMA standards.

Select from the following types, those cables with construction features which fulfill project requirements.

3. Individual Power Cable Construction.

   a. Conductors. Annealed stranded bare copper.
   b. Conductor Shield. Extruded thermosetting polyethylene layer.
   c. Insulation. Thermosetting, expanded cross linked polyethylene.
   d. Insulation Shield. Nonmetallic component shall consist of a semiconducting film over the insulation wrapped with semiconducting tape. Metallic component shall consist of bare copper wires helically applied.
   e. Jacket. Shall be heat, oil, acid, and sunlight resistant polyvinyl chloride.
   f. Cable Insulation Level. 133 percent as defined by AEIC.
   g. Cable Identification. Cables shall be identified on the exterior jacket by printing the cable conductor size, voltage class ground wire size, insulation thickness, MV-90, with the manufacturer's name and product identification.

4. Connectors.

   a. General. Provide UL type factory fabricated, metal connectors of sizes, ampacity ratings, materials, types, and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC, and NEMA standards. Select from the following those types, classes, kinds, and styles of connectors to fulfill project requirements.

      1) Type. Bolted pressure.
      2) Class. Noninsulated.
      3) Kind. Copper (for Cu to Cu connection).
      4) Kind. Aluminum-copper (for Al to Cu connection).
      5) Style. Terminator.
      6) Style. Splice.
      7) Style. T splice.
      8) Style. Terminal.

PART 3 - EXECUTION

3.1 Wires and Cables

1. General. Install electrical power cables and connectors as indicated in compliance with applicable requirements of NEC, NEMA, UL, and National Electrical Contractors Association's (NECA) "Standard of Installation," and in accordance with recognized industry practices.
2. Coordinate power/cable installation work including electrical raceway and equipment installation work as necessary to properly schedule installation of power/cables with other work.
3. Submittal. Submit record drawings showing the locations of all power cables.

4. Personnel. Use experienced personnel familiar with the materials and procedures to be employed for power/cable installation.
5. Splices and Terminations. Shall be in strict accordance with the cable manufacturer's recommendations and shall be watertight below grade in all manholes and pull boxes. All splices shall be made only by specific permission of the Engineer/Architect. Outdoor terminations shall utilize watertight terminating insulators. Indoor terminations shall utilize waterproof heatshrink to prevent moisture entry between insulating systems.
6. Pulling. Pull power cables simultaneously where more than one cable is being installed in a raceway and use pulling means and grips that will not damage the cables or raceway.
7. Pulling Tension. Shall be within the limits recommended by the cable manufacturer and a dynomometer shall be employed to monitor the pulling tension when mechanical pulling means are employed.
8. Pulling Compound. Shall be insulating type containing no mineral oil or soap. Shall be compatible with the power cable components.
9. Cable Ends. Shall be cut off where mechanical pulling means have been used and the cable ends shall be sealed until final terminations are made.
10. Bending Radius. Shall be limited to a minimum of eight times the power cable overall diameter.
11. Slack. Maximum slack shall be provided at all terminal points.
12. Fireproofing. Wrap power cables with fireproofing, self-extinguishing tape within all manholes or pull boxes. Tape shall not support combustion and shall be resistant to water, salt, sewage, and fungus.
13. Raceways for power cable shall be installed parallel and perpendicular to surfaces or exposed structural members and shall follow contours where possible.
14. Testing. All medium voltage cable shall be highpot tested in accordance with the AEIC latest applicable issue, section titled "Acceptance Testing." The test shall require high voltage direct current (dc) to be applied at 1 kilovolt (kV) per second until the acceptance voltage is reached (approximately 250 percent of cable rating). The test voltage shall be maintained for 15 consecutive minutes. Current flow in amperes shall be logged at 15 second intervals up to 1 minute and at 1 minute intervals thereafter. Each cable test shall be signed and dated by the tester and submitted to the Engineer/Architect for approval before it is energized. The Contractor shall provide a graphic plot of the leakage current versus voltage predicted for each cable prior to the highpot test. Actual test results shall be plotted on this predicted graph. Carefully dry and bag all exposed cable ends during testing.

15. Maximum leakage current should not exceed:

    $I_L = E \div (K \text{ LOG } D/d)$

    Furnish the following data prior to testing:

    Length of cable.
    K = insulation specific resistance Megohm/Mft at 60^o F.
    D = diameter over insulation.
    d = diameter under insulation.
    E = maximum test voltage.

16. Test Acceptance or Rejection. The Engineer/Architect shall determine acceptance or rejection. New power cable failing the test shall be replaced and retested until the cable satisfactorily passes the test.

END OF SECTION

SECTION 26 05 23

COMMUNICATION AND SIGNAL CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 12, "Wires, Cables, and Connectors," for ordinary building wire that may sometimes be used for control or signal circuits.
4. "Optical Fiber Cabling Systems," for systems such as telephone, television, and data transmission using fiber-optic cable.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install communication and signal cables in accordance with the plans and as specified herein.

B. **Cables and Accessories**. This section includes cables and connectors designed for and used in communication, control, data, and signal circuits including:

1. Twinaxial cable.
2. Shielded twisted pair cable.
3. Unshielded twisted pair cable.
4. Coaxial cable connectors.
5. Signal cable terminals.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Connected Equipment Manufacturer Approval**. Where cables specified in this section are used to provide signal paths for systems specified in other sections of these specifications or for systems furnished under other contracts, obtain review of the cable characteristics and approval for use with the connected system equipment by the connected equipment manufacturers.

C. **Electrical Component Standard**. Provide work complying with applicable requirements of National Fire Protection Association (NFPA) 70, "National Electrical Code (NEC)," and NFPA 262, “Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.”

D. **National Electrical Manufacturer's Association/Insulated Cable Engineers Association (NEMA/ICEA) Compliance.** Comply with NEMA/ICEA Standard Publication WC 70, “Nonshielded 0-2 kV Cables”; and WC 63.2, “Performance Standard for Coaxial Premise Data Communications Cables”.

E. **American Society for Testing and Materials (ASTM) Compliance.** Comply with applicable requirements of ASTM B 1, B 2, B 3, B 8, B 33, D 2219, and D 2220. Provide copper conductors with conductivity of not less than 98 percent at 20 degrees Celsius (° C.) (68 degrees Fahrenheit [° F.]).

F. **Underwriters' Laboratories, Inc. (UL) Compliance**. Comply with applicable requirements of UL Standard 83, "Thermoplastic-Insulated Wires and Cables"; and UL 486 A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide products that are UL listed and labeled.

G. **MIL-SPEC Compliance**. Comply with MIL-C-3093, "Telephone Cable; Inside Distribution Wiring," MIL-C-55021, "Twisted-Pair and Triplet Cables; Hookups General Specifications," MIL-C-17/28, "Radio Frequency Flexible Coaxial Cables, 50 Ohms," and MIL-C-17/29, "Radio Frequency Flexible Coaxial Cables, 75 Ohms."

1.4 SUBMITTALS

A. **General**. Furnish manufacturer's product data, test reports, and material certifications as required.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver wire and cable properly packaged** in factory-fabricated-type containers, or wound on NEMA-specified-type wire and cable reels.

B. **Store wire and cable in clean dry space** in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

C. **Handle wire and cable carefully** to avoid abrasing, puncturing, and tearing wire, cable insulation, and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of the cable are maintained.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **General**. Provide communication and signal cables of manufacturer's standard materials as indicated by published product information, designed and constructed as recommended by manufacturer, for a complete installation and for applications indicated.

2.2 **SIGNAL CABLES**

A. **300-Volt Rated Single Pair.** Shielded twisted pair cable, 18 American Wire Gauge (AWG), stranded- (tinned-) copper conductors, polyvinyl chloride (PVC) insulation, aluminum type shield, tinned copper drain wire, ultraviolet (UV) stabilized PVC jacket, 300-volt rated. UL listed as power limited tray cable. 100 percent shield coverage.

B. **300-Volt Rated Multiple Pair.** Multiple shielded twisted pairs as described above with an overall shield and UV stabilized PVC jacket, 300 volt rated. UL-listed as power limited tray cable.

C. **600-Volt Rated Single Pair.** Shielded twisted pair cable, 18 AWG, stranded (tinned) copper conductors, PVC insulation, aluminum type shield, tinned copper drain wire, UV stabilized PVC jacket, 600 volt rated. UL listed as tray cable. 100 percent shield coverage. Suitable for direct burial.

D. **600-Volt Rated Multiple Pair**. Multiple shielded twisted pairs as described above with an overall shield and UV stabilized PVC jacket, 600 volt rated. UL listed as tray cable. Suitable for direct burial.

2.3 **TELEPHONE CABLES**

A. **Nonplenum.** Four pair unshielded, Category 3, 24 AWG, stranded copper with PVC insulation and PVC jacket. Cable shall be UL listed, Occupational Safety and Health Administration (OSHA) acceptable, and rated VW-1 (passes the VW-1 flame test).

2.4 **TWINAXIAL CABLES.** Balanced pair twin axial cable, 125-ohm characteristic impedance, with 16-gauge soft drawn bare copper conductors twisted to form pairs; core insulation, expanded polyethylene; covered with copper shielding tape and with expanded polyester film.

2.5 **TWIN LEAD CABLES**. Bare copper-covered steel, two-conductor parallel, 300-ohm characteristic impedance, polyethylene insulation and web between conductors, cellular polyethylene oval jacket.

2.6 **CONNECTORS AND TERMINALS**

A. **Coaxial Cable Connectors.** Provide radio frequency, Type F cable connectors for RG-59/U flexible coaxial video cable.

B. **Provide terminals** for signal cable as specified in Section 26 05 12, "Wires, Cables, and Connectors."

2.7 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering control/signal cabling products that may be incorporated in the work include but are not limited to the following:

1. Cables.

a. Alpha Communications.
b. American Insulated Wire Corp.

c. Belden Communication Division.
d. Berk-Tek Company.
e. General Cable Corporation.
f. Mohawk CDT.
g. Phelps Dodge Corp.
h. Pirelli Cable Corp.

2. Connectors.

a. Thomas & Betts Corporation.
b. 3M Company.

PART 3 - EXECUTION

3.1 **INSPECTION.** Examine areas and conditions under which communication and signal cables are to be installed. Notify Engineer/Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer/Architect.

3.2 **COORDINATION.** Coordinate with other work, including wires/cables, boxes, and raceways, as necessary to interface installations of communication and signal cables with other work.

3.3 **APPLICATIONS**

A. **Use 300-volt rated single- or multiple-pair** signal cables for analog direct current (dc) signals (4-20 milliampere [mA], 1-5 volt, etc.) interior to buildings and in control panels where no circuit voltage exceeds 300 volts.

B. **Use 600-volt rated single or multiple pair** signal cables in all exterior or underground conduits, and in all pull boxes, control panels, or motor control centers where circuit voltages exceed 300 volts.

C. **Use nonplenum telephone cable** for telephone lines installed in conduit.

D. **Use nonplenum telephone cable** exposed above ceiling spaces not used as plenums.

3.4 **INSTALLATION**

A. **General.** Install communication and signal cables in accordance with manufacturer's written instructions, in compliance with NEC, and in accordance with standard industry practice.

B. **Coordinate installation** with other work.

C. **Install communication and signal cables** without damaging conductors, shield, or jacket. Do not, either, in handling or installation bend cable to smaller radii than minimum recommended by manufacturer. Ensure that medium manufacturer's recommended pulling tensions are not exceeded. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Use pulling means, including fish tape,

cable, rope, and basket weave wire/cable grips that will not damage cable or raceway.

D. **Install all cables** in conduit.

E. **Cables shall be installed** without splices.

F. **Tighten connectors and terminals**, including screws and bolts, in accordance with manufacturer's published instructions for torque tightening values.

G. **Cable Terminations.** Terminate cables on numbered terminal blocks where cable terminations are made on backboards and in cabinets and outlet boxes.

H. **Wiring at Backboards and Cabinets.** Install conductors parallel to and at right angles to walls. Bundle, lace, and train the conductors to terminal points with no excess. Use wire distribution spools at points where cables are fanned or conductors turned. Label each terminal.

I. **Conductor Terminations**. Terminate conductors of cables on terminal blocks using tools recommended by terminal block manufacturer.

3.5 GROUNDING

A. **Provide equipment grounding connections** for telephone systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL

A. **Prior to usage**, **test communication** and signal cables for electrical continuity and for short circuits. Test all cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts. Replace malfunctioning cable with new materials, then retest until satisfactory performance is achieved.

3.7 COMMISSIONING

A. **Subsequent to hookups of communication and signal cables**, operate communication and signal systems to demonstrate proper functioning. Replace malfunctioning cable with new materials, and then retest until satisfactory performance is achieved.

END OF SECTION

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SECTION 26 05 23.01

TELEPHONE DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section.

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 33, "Raceways."
4. Section 26 05 34, "Cabinets, Boxes, and Fittings."

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install the telephone distribution system(s) in accordance with the plans and as specified herein.

B. **The section includes telephone distribution** systems, including a provision for service by the telephone utility organization. It includes the distribution of instruments and switching equipment throughout the project, ready for installation under a separate contract.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with telephone distribution systems(s) in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Comply with National Fire Protection Association (NFPA) 70, "National Electrical Code (NEC)."

2. Nationally Recognized Testing Laboratory (NRTL) Listing. Provide materials that are listed and labeled.

a. The terms "Listed" and "Labeled." As defined in the "NEC," Article 100.
b. Listing and Labeling Agency Qualifications. A NRTL as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
c. Federal Communications Commission (FCC) Regulations. Comply with FCC Part 68, Chapter 1, "U.S. Code of Federal Regulations," Title 47 for all telephone system wire and cable connection components.

3. Coordination of Work. Coordinate the work of this section with the requirements of the Owner's telephone system supplier and of the telephone utility organization.

   a. Meet jointly with the representatives of the above organization and the Owner's representative to exchange information and agree on details of installation interfaces.
   b. Record agreements reached in the meeting and distribute the record to the other participants.

1.4 **SUBMITTALS**

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **General**. Submit the following according to Conditions of the Contract and Division 1 specification sections.

1. Product data for system components.
2. Record of field tests of system.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

Not used.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **CABLE AND WIRING COMPONENTS**

A. **Terminal Blocks**. Type 66 or 110, mounted on stand-off brackets.

B. **Jack Assemblies**. Eight position modular, latching, plug type, in flush mounting wall plate except as otherwise indicated.

1. Wall Plates. Designed for telephone service. Match those indicated for power receptacle outlets in same spaces for materials and finish. For wall telephone units, include provision for support of unit.

C. **Cable.** CAT 6e category, voice over IP application. Cable used in plenums shall be listed for use in plenums.

D. **Raceways.** Comply with Section 26 05 33, "Raceways."

E. **Boxes and Cabinets**. Comply with Section 26 05 34, "Cabinets, Boxes, and Fittings."

F. **Backboard.** 3/4-inch (19-mm) interior grade plywood. Where installed in wire closet, height and width must cover entire wall up to 8 feet (2.5 m) above floor, except as otherwise indicated.

G. **Building Entrance Telephone Equipment**. Provide UL 497 listed primary protectors for paired conductors, terminations, and grounding accessories to protect building entrance telephone lines per NEC Article 800. Provide terminations and primary protectors for each incoming pair as shown on the contract drawings plus 20 percent spare.

1. Available Manufacturers. Subject to compliance with requirements, manufacturers offering Building Entrance Telephone Equipment that may be incorporated into the work include, but are not limited to, the following:

a. Krone.
b. Approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. **Telephone Service**. Comply with telephone utility organization requirements as to details of the telephone service.

B. **Distribution System.** Install completely so system will be fully operational when telephone instruments and switching equipment are connected.

C. **Raceway.** Install telephone service and distribution raceway where indicated as specified in Section 26 05 33, "Raceways."

3.2 WIRING INSTALLATION

A. **Install cable without damaging** conductors or jacket. Do not bend cable to a smaller radius than minimum recommended by manufacturer. Do not exceed manufacturer's recommended pulling tensions. Pull cables simultaneously where more than one is being installed in the same raceway or at the same location. Use pulling compound or lubricant where necessary. Compound used must not damage conductor or insulation. Use pulling methods that will not damage cable or raceway, including fish tape, cable, rope, and wire cable grips.

B. **Wiring Method**. Install outlet boxes with jack assemblies at outlets. Connect to cable fished in wall except where walls are solid or filled with insulation. Install cable in raceway concealed in wall where walls are solid or filled with insulation. Terminate raceway with a bushing in ceiling space above outlet except as otherwise indicated. Run cable concealed in accessible ceiling space except as otherwise indicated.

C. **Cable Taps**. Install numbered terminal blocks where cable taps are made in wire closets and cabinets and in junction, pull, and outlet boxes. Install plywood backboards in telephone wire closets and cabinets.

D. **Wiring in Wire Closets and Cabinets**. Install conductors parallel to and at right angles to walls. Bundle, lace, and train the conductors to terminal points with no excess. Use wire distribution spools at points where cables are fanned or

conductors turned. Connect conductors that are terminated, spliced, or interrupted to terminal blocks. Label each terminal with designations approved by the telephone equipment supplier.

E. **Conductor Terminations**. Terminate conductors of cables on terminal block using tools recommended by terminal block manufacturer.

3.3 GROUNDING

A. **Install ground terminal** at service location and connect in accordance with Section 26 05 26, "Grounding."

3.4 IDENTIFICATION

A. **Identify telephone system backboards** and cabinets with the legend "Telephone." Identify terminals of terminal strip and jack outlets and pull and junction boxes with approved designations. Perform all identification in accordance with Section 26 05 53, "Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. **Test Notice**. Provide at least 10 days' notice in writing when the system is ready for final acceptance testing.

B. **Acceptance Tests**. Include the following for each pair or conductor of each cable run.

1. Continuity of pair loop.
2. Insulation resistance for pair loop. Use 500 V megger. Report evaluation of readings less than 1 megaohm.
3. Direct current (dc) Loop Resistance. Compare measured value with calculated resistance for each pair loop. Report evaluation of differences greater than 3 percent.

C. **Retesting.** Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify that the total system meets the specifications and complies with applicable standards.

D. **Report of Tests and Inspections**. Prepare a written record of inspections, tests, and detailed test results in the form of a test log.

E. **Tag all cables**, terminal blocks, outlets, and other components for which tests have been satisfactorily completed.

END OF SECTION

SECTION 26 05 23.03

FIBER-OPTIC CABLE AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

B. **Related Sections**

1. Section 26 05 23, "Electrical Identification."
2. Section 40 95 13, "Control Panels and Consoles."

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, materials, equipment, and incidentals required to provide a fiber-optic data highway cable and appurtenances as shown on the drawings, and as specified or required. The system includes, but is not limited to fiber-optic cables, connectors, patch panels, enclosures, and related appurtenances. The Ethernet and fiber optic cables shall be furnished and terminated by the system integrator, but installed by the Electrical Contractor.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in conformance with the following standards as referenced herein:

1. ANSI/TIA/EIA – American National Standards Institute/ Telecommunications Industry Association/Electronic Industries Alliance 4720000-A, "Generic Specification for Fiber-Optic Cable."
2. NIST – National Institute of Standards and Technology.

C. **Qualifications**

1. Manufacturer Qualifications. Manufacturer shall be experienced in manufacturing materials and equipment similar to that which is specified herein for at least 5 years with a record of successful in-service performance.

D. **Provide all products** in this section from the same supplier.

1.4 SUBMITTALS

A. General

1. All submittals shall be submitted in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. Submittal Package No. 1 – Product Data and Shop Drawings

1. Product Data.

    a. Manufacturer's product data sheets and complete construction details including physical characteristics of optical fiber, strength members, and jackets.
    b. Manufacturer's installation instructions, procedures, and specific tools.
    c. Overall dimension of cable.
    d. Manufacturer's cable storage requirements, including temperature.

2. Shop Drawings.

    a. Cable-pulling plan which specifies the sequence of work tasks, materials, and equipment. The information submitted must include termination data including the following:

        1) List of materials and accessories.
        2) Details of cable preparation.
        3) Method of applying materials (including quantities).
        4) Precautionary measures.
        5) Written statement from cable manufacturer that termination methods submitted are acceptable.
        6) Written statement from the termination manufacturer that the termination methods are suitable for the proposed application.

3. Quality Assurance Submittals.

    a. Design Data. Provide an optical link analysis for each fiber-optic link. Calculate point-to-point (transmit/receive) optical power loss of each fiber link using proposed installed cable lengths. Include all losses through connectors. Submit calculated values including sketches graphically showing the proposed cable route.
    b. Production Test Reports. Submit the following certified test reports: cable manufacturer's certified test data for attenuation and bandwidth and the maximum pulling strain allowed.
    c. Manufacturer's qualifications.
    d. Test Instrument Certification. Power meters shall have calibrations traceable to NIST standards. Calibrations on meters used for testing shall be less than 1 year old.

C. **Submittal Package No. 2 – Field Reports**

1. Field test reports as required in paragraph 3.2.

D. **Submittal Package No. 3 – Project Record Documents**

1. Actual routing.
2. Actual patch panel terminations and labeling.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Cable Delivery**

1. No cable older than 1 year is acceptable for delivery.
2. Ends of cable are to be kept sealed at all times, except when making terminations. Use methods approved by the cable manufacturer.

B. **Cable Storage**

1. Store cable in a facility where the temperature shall be at temperature recommended by the manufacturer for optimum workability.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. **Fiber-Optic Cable**

1. Corning Cable Systems.
2. Berk-Tek Co.
3. Or approved equal.

B. **Terminal Connectors**

1. Radiant Communication Corporation.
2. Or approved equal.

C. **Fiber-Optic Cable Patch Panels and Accessories**

1. Radiant Communication Corporation.
2. Or approved equal.

D. **Enclosures**

1. Manufacturers shall be as specified in Section 40 95 13.

E. **Fiber-Optic Jumper Cables**

1. Radiant Communication Corporation.
2. Or approved equal.

2.2 **MATERIALS**

A. **General**. Fiber-optic cable shall be provided for use in a wastewater plants. The cable types shall be multimode. All fiber-optic cable shall be routed in separate conduit power wiring. Any drop or branch fiber-optic cable from a patch panel to a building exterior shall be armored cable.

B. **Fiber-Optic Cable**

1. General Requirements. Multimode graded index (OM1 type for use in the facility between the building and single mode between the facility and the remote wells), 12-strand fiber cable, loose tube, buffered optical glass fiber cores cable shall meet requirements of ABSI/TIA/EIA 4720000-A. "Generic Specification for Fiber-Optic Cable" and:

   a. Cable shall be compatible with light-emitting-diode- (LED-) based transmission systems for multimode application and suitable for fiber-optic Ethernet local-area-network (LAN) standards including the point-to-point fiber-optic inter-repeater link (FOIRL) networks and ANSI standard fiber distributed data interface (FDDI) networks.
   b. Fibers shall be optical glass fiber cores. Cables with plastic fiber core construction are not acceptable.
   c. The number of cables and the number of fibers in each cable shall be as specified herein and as shown on the drawings.
   d. Fibers within the cable shall be color-coded so that each fiber may be individually identified. The color sequence suggested is as follows: blue, orange, green, brown, slate, white, red, black, yellow, and violet. Dashed versions of the same colors may be used to continue the sequence depending on the cable structure and fiber count.
   e. Materials used for fiber-optic cable shall present no environmental or toxicological hazards as defined by current industry standards and Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) standards or applicable federal or state laws or regulations.
   f. Cable shall be assembled with dielectric inner strength members, polyester core separator tape, Aranid yarn, or similar strength members.
   g. Attenuation losses shall be 3.5 decibels per kilometer (dB/km) or less at a wavelength of 850 nanometers (nm) and 1.0 dB/km or less at a wavelength of 1300 nm.
   h. Bandwidth. Minimum bandwidth shall be 160 megahertz-(MHz-) km at 850 nm and 500 MHz-km at 1300 nm.
   i. Provide cable unaffected by continuous or intermittent submergence in water, or damage from lightning strikes. Cable shall be resistant to fuel, petrochemicals, and other caustic or noxious materials.

j. Cable shall be suitable for indoor and outdoor use and for installation in conduit.
k. Provide continuous inter- and intrabuilding installation, closet to closet, suitable for passing through inside conduit locations directly from outside conduit.
l. Cable shall be Underwriters' Laboratories, Inc. (UL) listed as type OFN per National Electrical Code (NEC) 770-51 and NEC 770-53.
m. Operating Temperature. -40 to +80 degrees Celsius (° C.).

2. Cable Types.

a. Multimode, graded index, armored, loose tube, buffered.

1) Fiber Size. 62.5 to 125 micron (core/cladding).
2) Fiber Count. As shown on drawings.

b. All Fiber Optic Cables shall be 12-strand for underground installation. The fiber optic cables shall be “Gel Fill” type and inter ducts.

3. Jacket.

a. Indoor cable runs shall leave inner polyvinyl chloride (PVC) jacket with rip cord and polyethylene outer jacket with rip cord. Outer jacket shall be ultraviolet (UV) inhibited, fungus resistant, and flame retardant.
b. Outdoor/aerial cable runs shall have inner PVC jacket with rip cord, corrugated steel tape armor.
c. Inner and outer jackets shall be continuous, free from holes, splits, blisters, or inclusions.

4. Cable Packaging.

a. The cable shall be permanently marked to identify the manufacturer, date of manufacture, length markings, a product identification code, and UL messages where appropriate. The markings shall be printed at regular intervals of not more than 2 feet apart.
b. The cable shall be packaged on a reel with inner hub diameter greater than the recommended minimum bending diameter of the cable. The anchor holes on the reels shall admit a 2-1/2-inch-diameter spindle without binding. The package shall be sturdy enough to endure reasonable handling in the process of shipping and storage. The package shall bear the name of the manufacturer, the product identification code, and the total amount of product on the reel.

5. Splicing/Splitting.

a. Splitter Kits. The cable shall be provided with the necessary number of splitter kits to accommodate the number of terminations shown for each interconnection box on the

drawings. Splitter kits shall be suitable units manufactured by the cable manufacturer.

b. Contractor shall field-splice each fiber to a pigtail cable at the termination enclosures. All splices shall be made by the fusion process and shall have a splice loss no greater than 0.34 dB. Loss measurement shall be performed at the time of splicing, and documentation shall be furnished for each splice. Splice testing shall be witnessed by the Engineer. Prior to stripping the cable. The Contractor shall record the cable length from the cable jacket. This length shall be documented and included in the test documentation.

C. **Terminal Connectors**

1. Furnish connector micron core/claddings and components and use specific tools and methods as recommended by the connector manufacturer to form a complete connector system.

2. Provide fiber-optic SC simplex connectors, multimode to match cable type. Connectors shall be polymer body with precision zirconia ferrules.

a. Connector Specifications.

1) Insertion Loss. 0.15/0.30 dB (typical/maximum).
2) Durability Delta. 0.1 dB (1000 matings).
3) Operating Temperature. -40 to +80° C.
4) Cable Retention. 40 pounds.

D. **Fiber-Optic Cable Patch Panels**

1. All fiber-optic patch panels shall be provided in enclosures.
2. Provide fiber-optic cable patch panels as referenced on the drawings and which meet the following requirements.

a. Furnish panels with the following accessories.

1) Trays.
2) Cable strain relief.
3) Bend radius protectors.
4) Routing guides.
5) Grommetted cable entries.
6) SC simplex adapters and adapter plates.
7) Sufficient working space for removal of connectors.
8) Identification label.
9) All cable management hardware required to accomplish the installation.

b. It is acceptable for the accessories to be installed in a separate enclosure inside the one large enclosure.

c. Furnish each cabinet with a key-lock and two keys. All cabinets provided are to be keyed alike so that a single key opens all cabinets.

d. Furnish cabinets with internal space to store, organize, and strain-relieve incoming and outgoing cables.

e. Ground lug for cable support member and routing supports to maintain allowable cable bend radius.

3. Where the required number of terminations exceeds the capacity of a single patch panel. Multiple patch panels shall be provided. These multiple patch panels shall be enclosed in a single enclosure.

4. Patch panel features and qualities shall be the same for multimode cable.

5. Provide labeling for patch panel terminations.

E. **Enclosures**

1. Material shall be as indicated in Section 40 95 13, "Control Panels and Consoles."
2. Enclosure shall house patch panels and fiber-optic cables as shown on the Contract drawings. Enclosure shall be wall- and rack-mount type and of adequate size to house all the components.
3. Individual front door for each enclosure with engraved nameplate identifying equipment per Section 26 05 23, "Electrical Identification."
4. Minimum size shall be 24 inches wide, 24 inches high, and 12 inches deep.
5. A clearance of approximately 6 inches inside the enclosure around the patch panels shall be provided.

F. **Fiber-Optic Jumper Cables**

1. Provide fiber-optic jumper cables, 62.5- to 125-micron multimode fiber compatible with fiber cable specified herein, complete with SC simplex-type connectors, and PVC jacket. Provide a quantity equal to the total number of fibers terminated.
2. System shall use Microsoft Sans Serif font or a similar Sans Serif font.
3. Print labels with a minimum font size of 8 point.

2.3 **SOURCE QUALITY CONTROL**

A. **Fiber-optic cable and appurtenances** shall be UL listed.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **Install cable and connectors** as indicated on the drawings and as specified in this section.

B. **Install cables** in the indicated raceway systems. Inspect raceways prior to pulling cables. Rod and swab out conduits and ducts prior to installing cables.

C. **Pull cables** prior to attachment of connectors. Terminate all fibers at each patch panel. Install jumper cables at each patch panel as shown on the drawings.

D. **Pull cables** using an indirect attachment method such as a Kellems grip or equal which distributes the pulling forces over the outer portion of the cable. Pulls directly on the fiber core will not be allowed.

E. **Do not exceed** maximum pulling strength limits of the cable during installation. Monitor cable pull tensions at all times during the installation of the cable using a remote sensing puller, strain gauge, or running line tensiometer. If electronic tension monitoring equipment is used, it shall be calibrated or checked for calibration on a daily basis or prior to any cable pull.

F. **To reduce cable friction** and minimize pulling forces during installation, use a polymer-based, water-soluble lubricant when pulling cable.

G. **Do not exceed** the minimum bend radius of the cable. Tight loops, kinks, knots, or tight bends will not be allowed during installation.

H. **For conduit installation**, the minimum bending radius shall be 8 inches. Use sweeping elbows at all transitions from horizontal to vertical conduit runs.

I. **Do not make splices** in cable. Provide adequate run lengths on cable reels to mare termination-to-termination runs without splices.

J. **Provide handholes and pull boxes** as required by the cable manufacturer.

K. **Within manholes**, route and support fiber-optic cable along the inside wall and protect using PVC conduit.

L. **Install patch panels** at the locations shown on the drawings.

M. **Identification meeting the requirements** of Section 26 05 23, "Electrical Identification," shall be provided for each cable at each junction box, pull box, manhole, and handhole.

3.2 FIELD QUALITY CONTROL

A. **The Contractor shall supply** all necessary test equipment and qualified personnel to perform tests described by this specification.

B. **Test fiber-optic cables** before and after field installation.

1. Upon receipt of the fiber-optic cable reels, test each fiber separately with an optical time domain reflectometer (OTDR) to verify fiber length, attenuation, and continuity.

2. After the cable has been installed, visually inspect each fiber termination for out-of-round conditions and surface defects such as cracks and microchips using a 200x inspection microscope.

3. After connectors have been attached at both ends, test each fiber with an OTDR. Tests shall be bidirectional. End-to-end tests shall be performed from both ends of the fiber.

4. Test all fibers including spares. Test shall include, but not be limited to, to the following:

a. Check candle power transmitted through each fiber in the data highway fiber-optic cable. If the light transmitted through the cable does not meet the requirements of the installed equipment, then check all connectors on the fiber cable for proper installation. Replace all bad connections. Replacement shall be done at the Contractor's expense.

b. If a section of the fiber-optic cable is not transmitting light to the requirements of the installed equipment, then replace that section of the cable between terminations. Replacement shall be done at the Contractor's expense.

5. The test shall be signed by the tester and initialed by the Engineer.

C. **Furnish certification documents** for each test to the Engineer. Include printouts from the OTDR with the certification documents. Record the following data:

1. Installer's company name and address.
2. Installer's name.
3. Date of certification.
4. Attenuation of each fiber-optic link.
5. Length of each fiber-optic link measured.
6. Equipment used to certify the fiber-optic link.
7. Name of person(s) recording the test data.

D. **The maximum total loss** including connectors and cable attenuation for each fiber-optic link shall not exceed 7.5 dB.

E. **Cable Energizing**. No cable shall be energized until the master copy of its test record is approved by the Engineer.

END OF SECTION

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SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 12, "Wires, Cables, and Connectors."
4. Section 26 05 53, "Electrical Identification."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install grounding materials in accordance with the plans and as specified herein.

B. **Grounding.** This section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this section may be supplemented in other sections of these specifications.

C. **Applications of electrical grounding** and bonding work in this section include the following:

1. Underground metal water piping.
2. Underground metal and steel reinforced concrete structures.
3. Metal building frames.
4. Electrical power systems.
5. Grounding electrodes.
6. Separately derived systems.
7. Raceways.
8. Service equipment.
9. Enclosures.
10. Equipment.
11. Lighting standards.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install grounding in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Electrical Code Compliance. Comply with applicable local electrical code requirements of the authority having jurisdiction, and American National Standards Institute/National Fire Protection Association

(ANSI/NFPA) 70, "National Electrical Code" (NEC), as applicable to electrical grounding and bonding, pertaining to systems, circuits, and equipment. Comply with the latest edition of the codes listed above.

2. Underwriters' Laboratories, Inc. (UL). All grounding system components and materials for which UL maintains a testing and listing service shall be UL listed. Comply with the applicable requirements of the following UL standards:

   a. 467, "Electrical Grounding and Bonding Equipment."
   b. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors."
   c. 486B, "Wire Connectors for Use with Aluminum Conductors."
   d. 486C, "Splicing Wire Connectors."
   e. 869, "Electrical Service Equipment."

3. ANSI/Institute of Electrical and Electronics Engineers (IEEE). Comply with applicable provisions and recommended installation and testing practices of the following ANSI/IEEE standards:

   a. 80-1986, "IEEE Guide for Safety in AC Substation Grounding."
   b. 81-1983, "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounded System (Part 1)."
   c. 141-1993, "IEEE Recommended Practice for Electric Power Distribution for Industrial Plants."
   d. 142-1991, "IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems."

4. ANSI Standard C2-1993, "National Electrical Safety Code" (NESC).

1.4 SUBMITTALS

A. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections:

1. Product data for each type of product specified.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver ground wire properly packaged** in factory-fabricated-type containers, or wound on National Electrical Manufacturers Association (NEMA) specified type wire reels.

B. **Store grounding materials** and ground wire in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

C. **Handle grounding wire carefully** to avoid abrading, puncturing and/or tearing wire insulation. Ensure that dielectric resistance of the cable insulation is maintained.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **GROUNDING CONDUCTORS**

A. **General**. Provide types indicated. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

B. **Bare Conductors**

1. Copper Conductors. Conform to the following:

a. Solid Conductors. American Society for Testing and Materials (ASTM) B 3.
b. Assembly of Stranded Conductors. ASTM B 8.
c. Tinned Conductors. ASTM B 33.

C. **Insulated Conductors**. Refer to Section 26 05 12, "Wires, Cables, and Connectors."

D. **Ground Bus**. Bare (tin-plated), annealed, 98 percent conductivity copper bars of rectangular cross section, 1/4" x 3" x length as required. Cable lug hole spacing 2 inches center to center minimum.

E. **Braided Bonding Jumpers**. Flexible, 153,700-circular-mil braid, formed with 30 AWG tin-plated copper wire and terminated with crimp-type copper connectors or ground connector for copper braid to rod or tube.

F. **Bonding Strap**. Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.2 **GROUNDING ELECTRODES**

A. **Ground Rods**. One piece, copper clad steel with high strength steel core and electrolytic grade copper cladding 3/4" x 10’.

B. **Ground Enhancement Material**. Ground enhancement material shall be permanent and maintenance-free (no recharging with salts, chemicals, or water) and shall maintain earth resistance over time. It shall set up firmly and not dissolve, decompose, or otherwise pollute the soil or water table. The ground enhancement material shall be suitable for installation in either dry or slurry form, and shall not depend on continuous presence of water to maintain conductivity. The material shall have a resistivity of less than 20 ohm-cm. Ground enhancement material shall be GEM produced by Erico Products, Inc.

C. **Enhanced Grounding Electrode**. 2 inch trade size Type K copper tube, minimum 10 feet long or longer as required by the Contract Documents, straight or L-shaped as required by subgrade conditions, capped on both ends, perforated with breather holes at the top and leach holes at the bottom, and partially filled with nonhazardous metallic salts. A short length of 4/0 AWG copper cable shall be welded to the tube for connection to the grounding electrode conductor, and a U bolted pressure plate connection shall be provided just under the top cap for a test point. Product shall be listed under UL 467J and ANSI 633.8, and shall include bentonite backfill material and protective flush box with grate type lid consistent with its listing.

D. **Test Wells.** Provide a 12-inch-square-by-12-3/4-inch-deep box with heavy-duty locking cover and set box flush in a 5-foot-square-by-8-inch-deep cast-in-place reinforced concrete pad having top flush with finished grade. Box and lid shall be fabricated from a material consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. Material shall have a compressive strength of 11,000 pounds per square inch (psi), tensile strength of 1,700 psi, and flexural strength of 7,500 psi. Lid shall attach with stainless steel machine bolts and shall be capable of supporting 15,000 pounds over a 10" x 10" area. Pad shall be constructed of 4,000 psi concrete with 6 percent entrained air and with broom finish. Pad reinforcement shall be No. 6, 6" x 6" mesh, placed 3 inches above the bottom of the slab.

2.3 CONNECTORS

A. **General**. Listed and labeled as grounding connectors for the materials used.

B. **Pressure Connectors**. High-conductivity plated units.

C. **Bolted Clamps**. Heavy-duty units listed for the application.

D. **Exothermic Welded Connections**. Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

E. **Aluminum-to-Copper Connections**. Bimetallic type, conforming to UL 96, "Lightning Protection Components," or UL 467.

2.4 ACCESSORIES

A. **Ground Staple**. Square shank, barbed, hot dipped galvanized.

B. **Ground Wire Guards**. 1" x 8'-0" molded, ultraviolet-light-stabilized plastic.

2.5 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Anixter Bros., Inc.
2. Burndy Corporation.
3. A.B. Chance Co.
4. Dossert Corp.
5. Erico Products, Inc.

6. Heary Bros., Inc.
7. Ideal Industries, Inc.
8. ILSCO.
9. Joslyn Manufacturing Co.
10. Lyncole XIT Grounding Div., Lyncole Industries, Inc.
11. Thomas and Betts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Ground electrical systems and equipment in accordance with NEC requirements except where the Contract Documents exceed NEC requirements.
2. Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors and grounding electrode conductors, except that larger sizes indicated or shown on the Contract Documents shall take precedence.
3. Connect each grounded service conductors to a grounding bus at each building. See electrical site plan for locations and details.

B. Grounding Electrodes

1. Ground Rods. Provide at least one ground rod at each building. Locate ground rods a minimum of one rod length from each other and at least the same distance from any other grounding electrode. Connect ground conductors to ground rods by means of exothermic welds except at test wells and as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel of the rod. Drive rods until tops are 24 inches below finished floor or final grade except as otherwise indicated.

2. Ground Enhancement Materials. Where required by the Contract Documents, provide ground enhancement material for grounding electrodes.

    a. Drill a 12-inch-diameter hole to a depth of 1 foot less than the bottom of the ground electrode. Drive the grounding electrode 1 foot into the bottom of the shaft. Install ground enhancement material to within 1 foot of finished grade.
    b. Install monument case over ground rod and finish filling the shaft to surface as required. Monument case shall remain accessible, and connections to the grounding electrode shall remain visible when the monument case cover is removed.

3. Enhanced Grounding Electrode.

    a. Provide enhanced grounding electrodes as follows:

        1) Where shown on the Contract Documents, or
        2) In the event that multiple driven grounds cannot provide the required resistance to earth.

b. Set tube vertically in a 6-inch-diameter drilled hole backfilled the first 6 inches with soil or gravel and the balance of the way up to within 4 inches of the top of the tube with a bentonite slurry, per manufacturer's instructions.

c. Place system protective box with grating type cover over the tube and grout in flush with finished grade, maintaining the inside of the box free and clear and open to the atmosphere.

d. Comply with all manufacturer installation instructions.

e. In the event that the site is rocky and a vertical installation is impossible, provide an L shaped tube type chemically enhanced grounding electrode and install it in a 12-inch-wide trench a minimum of 30 inches deep such that the tube slopes down at the minimum rate of 1/8 inch per foot, beginning at the crook of the L shape. Comply with c and d above.

4. Metallic Water Service Pipe. Provide insulated copper grounding electrode conductors, sized per NEC 250.66, in conduit from the building to main metallic water service entrances to the building. Connect grounding electrode conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the grounding electrode conductor to the street side of the fitting. Do not install a bonding jumper around dielectric fittings. Bond metallic grounding electrode conductor conduit to the conductor at each end.

5. Test Wells. Locate as indicated.

C. **Conductors**

1. Grounding Electrode Conductors.

a. Interconnect all grounding electrodes with a grounding electrode conductor sized as shown on the plans or as required by the NEC.
b. Route grounding electrode conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
c. Bury exterior grounding electrode conductors at least 30 inches below grade.
d. Use bare, tinned, stranded copper except as otherwise indicated.
e. Use bare, stranded copper except as otherwise indicated.

2. Equipment Grounding Conductors.

a. Provide equipment grounding conductors in all conduits containing power, control, or instrumentation conductors on the load side of the service equipment or on the load side of a separately derived system.

b. Use insulated copper conductors up to No. 6 AWG. Use bare stranded copper for sizes No. 4 AWG and larger.

3. Braided-Type Bonding Jumpers. Install to connect ground clamps on water meter piping to bypass water meters electrically except in the situation in which a solid, full capacity bypass piping system is installed. Use elsewhere for flexible bonding and grounding connections, such as bonding metal fence gate leaves to their support posts.

D. **Grounding Connections**

1. General. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

   a. Use electroplated or hot tin coated materials to ensure high conductivity and make contact points closer in order of galvanic series.
   b. Make connections with clean bare metal at points of contact.
   c. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
   d. Aluminum to galvanized steel connections shall be with tin plated copper jumpers and mechanical clamps.
   e. Coat and seal connections involving dissimilar metals with inert material such as bituminous paint to prevent future penetration of moisture to contact surfaces.

2. Exothermic Welded Connections. Use for connections to structural steel and for all underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
3. Connections at Test Wells. Use compression type connectors on conductors and make bolted and clamped type connections between conductors and ground rods.
4. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a grounding conductor to a ground bus or stud in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and grounding conductors. Size bonding conductors per NEC 250.122 based upon the largest overcurrent protection device trip setting for any contained conductor.
5. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

6. Compression Type Connections. Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
7. Moisture Protection. Where insulated grounding conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.
8. Ensure that grounding electrode conductor connections to interior piping, structural members, and the like are accessible for periodic inspection during the life of the structure.

E. **Equipment Grounding**

1. Separately derived systems required by NEC to be grounded shall be grounded in accordance with NEC 250.30. In addition, bond the grounded conductor of the separately derived system to the nearest available point on the interior metal water piping system, per NEC 250.104(A), and wherever available to a line side feeder ground conductor.

2. Building Steel. Exposed structural steel building framework shall be bonded to the grounding electrode conductor with a conductor of the same size as the service entrance grounding electrode conductor, per NEC 250.104(C).

3. Utilization Equipment.

    a. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

    b. Air Duct Equipment Circuits. Install an insulated equipment grounding conductor to duct mounted electrical devices operating at 120 volts and above including air cleaners and heaters. Bond the conductor to each such unit and to the air duct.

    c. Electric Heating Equipment. Provide an insulated equipment grounding conductor to any of the following equipment:

        1) Water Heaters. Bond to enclosure, to grounding terminals on heater units, and to piping.
        2) Heat Tracing. Bond to grounding sheath of heater cable and to piping. Bond to thermostat and other metallic equipment and enclosures.
        3) Sidewalk/Step/Floor Heater and Snow Removal Cable. Bond to grounded sheath of heater cable and to metallic equipment and enclosures.

4) Roof Edge Snow Melt Cable. Bond to grounded sheath of heater and to metallic enclosures, gutters, and downspouts.

4. Underground Distribution System Grounding.

a. Manholes and Handholes. Provide a driven ground rod close to the wall and set the rod depth such that 4 inches will extend above the finished floor. Where necessary, install ground rod before the manhole is placed and provide a 1/0 AWG bare tinned copper conductor from the ground rod into the manhole through a sleeve in the manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure sensitive tape or heat shrunk insulating sleeve from 2 inches above to 6 inches below the concrete.

b. Connections. Ground all non-current-carrying exposed metal parts associated with manholes, substations, and pad-mounted equipment to the ground rod or ground conductor. Make connections with minimum No. 4 AWG stranded copper wire. Train conductors plumb or level around corners and fasten to manhole walls. Connect to cable armor and cable shields by means of tinned terminals soldered to the armor or shield, or as recommended by manufacturer of splicing and termination kits. Interconnect bare grounding conductors carried with incoming or outgoing circuits with the manhole grounding system.

c. Grounding System. Ground non-current-carrying metallic items associated with manholes, substations, and pad-mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

5. Overhead Line Grounding.

a. General. Comply with ANSI C2, "National Electrical Safety Code" for "Single Grounded Systems," using two or more electrodes in parallel if a single electrode resistance to ground exceeds 25 ohms.

b. Ground Rod Connections. Use exothermic welds for underground connections and connections to rods.

c. Lightning Arresters. Separate arrester grounds from other ground conductors to separate ground rods. Interconnect ground rods underground.

d. Secondary Neutral and Tank of Transformer. Interconnect and connect to grounding electrode system.

e. Attach grounding conductor to wood poles with ground staples. Staples shall be 2’-0" apart, except for a distance of 8’-0" above grade and 8’-0" from top of pole where they shall be 6 inches apart.

f. Protect grounding conductors running on the surface of wood poles with guards. Install guards to 8’-0" above grade.

6. Metal Light Poles. Provide each light pole with a driven ground rod. Provide a grounding electrode conductor for connecting the rod to the pole and to the branch circuit ground conductor.

a. Bond light poles, metallic conduit systems, and metallic junction boxes to the structure grounding system with 2/0 AWG cable. Bond light fixtures without poles to the branch circuit grounding conductor and to the structure grounding conductor (if present) with conductor sized per NEC 250-122, except not smaller than 4 AWG.

F. **Isolated Ground System**

1. Provide a parallel system of insulated equipment grounding conductors, isolated from the conduit system and enclosures, to provide a quiet ground for isolated ground receptacles and equipment provided with isolated ground buses.
2. The isolated grounding system shall be connected to the facility [grounding electrode conductor at the service equipment] [ERGB].
3. Clearly identify all isolated ground conductors at all access points in the conduit system to differentiate between isolated grounding and other grounding conductors.
4. Signal and Communications. For telephone, alarm, and communication systems, provide a No. 4 AWG minimum green insulated copper conductor in raceway to each terminal cabinet or central equipment location.

3.2 FIELD QUALITY CONTROL

A. **Tests**. Subject the completed grounding system to a ground resistance test at each location where a maximum ground resistance level is specified and at service disconnect enclosure ground terminal. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by [the three-point method] [the fall-of-potential method].

B. **Ground/resistance maximum values** shall be as follows:

1. Equipment Rated 500 Kilovolt Amperes (kVA) and Less. 10 ohms.
2. Equipment Rated 500 kVA to 1000 kVA. 5 ohms.
3. Equipment Rated over 1000 kVA. 3 ohms.
4. Unfenced Substations and Pad Mounted Equipment. 5 ohms.
5. Manhole Grounds. 10 ohms.
6. Structure Grounds. 25 ohms.

C. **Deficiencies**. Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated, the provisions of the Contract covering change orders will be applied.

3.3 CLEANING AND ADJUSTING

A. **Restore surface features** at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas

disturbed by trenching, storing of dirt, cable laying, and other work to their original condition. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging, or mulching. Perform such work in accordance with Division 32 section "Landscape Work." Maintain disturbed surfaces. Restore vegetation in accordance with section "Landscape Work." Restore disturbed paving as indicated.

3.4 LABELING

A. **Provide labeling for the grounding system** as specified in Section 26 05 53, "Electrical Identification."

3.5 DEMONSTRATION

A. **Provide a verification tour** of all grounding electrode conductor connections for the Engineer and the Owner. Review test reports which verify compliance of ground system with Contract requirements.

END OF SECTION

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SECTION 26 05 29

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 05 10 00, "Structural Steel," for steel shapes used to fabricate assemblies employed in the support of electrical systems and equipment.
2. Section 26 00 01, "Basic Electrical Requirements."
3. Section 26 00 02, "Basic Electrical Materials and Methods."

1.2 DESCRIPTION OF THE WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install supporting materials and assemblies, sleeves, and seals in accordance with the plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install supporting devices in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Code (NEC) Compliance. Components and installation shall comply with National Fire Protection Association (NFPA) 70 (NEC).
2. Certification. Manufactured electrical components shall be listed and labeled by either Underwriters' Laboratories, Inc. (UL), Electrical Testing Laboratories, Inc. (ETL), Canadian Standards Association (CSA), or other approved, nationally recognized testing and listing agency that provides third party certification follow-up services.
3. Manufacturers Standardization Society (MSS) Compliance. Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.
4. National Electrical Contractors Association (NECA) Compliance. Comply with NECA's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
5. Federal Specification (FS) Compliance. Comply with FS FF-S-760 pertaining to retaining straps for conduit, pipe, and cable.
6. Metal Framing Manufacturers Association Standard Publication (MFMA)-1.
7. American Institute of Steel Construction "Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings," including "Commentary" of supplements thereto, as issued.
8. The Aluminum Association "Specifications for Aluminum Structures."

B. **Supports, anchors, sleeves, and seals** furnished as part of factory fabricated equipment are specified as part of that equipment assembly in other divisions and Division 26 sections.

1.4 **SUBMITTALS**

A. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections:

1. Product data for each type of product specified.
2. Hanger and support schedule showing manufacturer's figure, number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.
3. Shop drawings indicating details of fabricated support assemblies.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Deliver supporting materials** and assemblies properly packaged in sturdy factory fabricated containers.

B. **Store supporting materials** and assemblies in clean, dry spaces in original containers. Protect from weather, damaging fumes, debris, and construction operations.

C. **Handle supporting materials** carefully to avoid damage.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MANUFACTURED SUPPORTS**

A. **General**. Provide manufactured support devices which are listed and labeled. In the event that more than one type of supporting device meets the requirements of the project, and none is specifically indicated on the drawings, device selection is the Contractor's option.

B. **Materials**

1. U-channel shall be cold rolled steel, American Society for Testing and Materials (ASTM) A 570, Grade 33, cleaned, primed, and finished in the manufacturer's standard rust inhibiting finish. Clamps, hangers, and hardware shall be steel with electroplated zinc finish or malleable iron.
2. U-channel, clamps, and hangers for supporting conduit and equipment shall be Type 316 stainless steel. Parts, screws, nuts, and rod shall be Type 316 stainless steel. Strut extruded from aluminum alloy 6036-T6

may be substituted for stainless steel where it will not be in contact with concrete or grout and when its strength is sufficient for the application.

3. Provide fittings and accessories made from aluminum alloy 5052-H32 for aluminum strut.
4. Malleable iron fittings and accessories shall be high tensile strength and ductility, ASTM A 47 or ASTM A 48, Class 30A, zinc electroplated, with aluminum lacquer or powder paint finish.

C. **Products shall include** but are not limited to the following:

1. Clevis Hangers. Steel for supporting rigid metal conduit, with 3/8-inch hanger rod through 2-inch conduit size; 1/2-inch hanger, 2-1/2-inch and larger conduit size.

2. Round Steel Rod. Zinc plated, threaded at ends only, 1/2-inch minimum size except as stated in 1 above, with zinc plated hexagon nuts.

3. Beam Clamp. Malleable iron with 1/4-inch tapped side and back holes for attachment of conduit clamps.

4. Swivel Beam Clamp. Malleable iron for use with hanger rod. Clamp to have swivel eye hook, closed in the installed position, and malleable iron swivel eye tapped for the hanger rod to which it is attached. Provide jamb nut.

5. I-Beam Clamps. Steel, 1-1/2-inch-x-3/16-inch stock, 1/2-inch hook rod in 8-, 11-, or 14-inch lengths, as required, with double eye swing connector threaded for 1/2-inch rod. Provide jamb nut for support rod.

6. Conduit Straps. Malleable iron, one hole.

7. Clamp Backs. Malleable iron, for use with one hole conduit strap to support conduit away from wall or ceiling surface.

8. Two-Hole Conduit Straps. Steel, minimum 1/8-inch-thick heavy-duty, zinc electroplated.

9. Conduit Hangers. Steel, zinc electroplated, for hanging conduit from beam clamps. With 1/4-inch, 20-thread, zinc electroplated closure bolt and square nut. Provide 1/4-inch, 20-thread zinc-electroplated stove bolt to secure hanger to beam clamp.

10. Duct Bank Conduit Spacers. Nonmetallic spacers to support conduit and maintain spacing during concrete pours.

11. Riser Clamps. Two cold rolled steel bars, formed to fit the conduit to be supported, 8-1/2-inch-plus-conduit trade diameter long by 1-inch tall (2 inches for 5 inch and larger trade size conduit) by 3/16-inch-thick (1/2 inch through 1-1/2-inch trade size; 1/4 inch thick, 2- through 6-inch trade size), with zinc-electroplated finish. Bars shall be secured around conduit with two electroplated hexhead cap screws and hex nuts.

12. Fasteners and Anchors. Provide fasteners and anchors to assemble supports and to secure supports to structures. Fasteners, including bolts, nuts, washers, self-tapping anchors, and expansion anchors to be installed out-of-doors, below grade level, or in corrosive atmospheres or process areas shall be stainless steel.

    a. Anchors for securing 3/4- or 1-inch conduit straps and device boxes to sound concrete walls and ceilings shall be self-tapping anchors, similar and equal to Hilti Kwik-Con II or ITW Buildex Blue Max, 3/16 inch by minimum 1-1/4 inches long, in areas not requiring stainless steel.
    b. For anchors for use in securing conduit larger than 1 inch, heavier equipment than device boxes, and all fasteners to be used in areas enumerated above as requiring stainless steel fasteners, provide stud type expansion anchors, drop-in two-piece expansion anchors, or adhesive stud anchors, similar and equal to Hilti Kwik-Bolt II, Hilti HDI Drop-in, or Hilti HVA Adhesive Anchor System.
    c. Fasteners for securing conduit or equipment to metal plate or metal structural members shall be welded studs applied by the electric arc method. Studs for stainless steel or aluminum shall be of the same material as the base metal. Studs for use in damp or wet environments or out-of-doors shall be stainless steel for use on low carbon steel or stainless steel. Studs shall be similar and equal to TRW Nelson Stud Welding Division low carbon or mild steel or Type 304 or 305 stainless steel, applied with a Nelson stud welder.

13. Provide external cable grips for all flexible cords and cables falling under the purview of NEC Article 400, longer than 6 feet, which do not contain an internal dedicated steel support wire. Grips shall be split mesh type capable of being installed and removed with the cable connected to the supply fitting and the supplied equipment. Mesh shall be high grade tin coated bronze strand for cable supports in noncorrosive interior applications and Type 302/304 stainless steel for exterior or corrosive atmosphere interior installations. Grips shall be lace type (not rod type) and shall be single or double weave as required to support the load with a support safety factor of 10 times the supported load plus 250 pounds. Grips shall be similar and equal to Kellems 022 series.

14. U-Channel. 1-1/2" x 1-1/2" 12-gauge cold rolled steel, 12-gauge stainless steel, or 0.1046-inch-thick extruded aluminum, with solid base or bolt-hole base as required. Provide spring nuts or spring studs and related hardware of material specified hereinbefore appropriate to the U-channel material.

15. Lightweight U-Channel. 5/16" x 1/2" nominal, 18-gauge cold rolled steel, pregalvanized, for support of surface lighting fixtures mounted on the underside of suspended ceiling systems or outlets flush in suspended ceiling systems. Provide 1/4-inch threaded rod and square nuts, box mounting studs, and channel fasteners as appropriate.

16. Perforated Sheet Steel. Provide perforated 11-gauge Type 316 stainless steel sheet. Sheet shall have 1/4-inch holes on 3/8-inch centers. Provide sizes as shown on the contract documents.

2.2 STRUCTURAL SHAPE SUPPORTS

A. **General**. Provide structural shape supports in the form of individual structural steel angles, channels, or W-shapes as shown on the drawings or required to support equipment or systems.

B. **Supports**

1. Materials.

   a. Steel shapes, such as angle, channel, or W-shapes, shall be fabricated from ASTM A 36 cold-rolled steel.

2. Finishes.

   a. Shapes shall be cleaned, phosphated, and primed with a rust inhibiting primer. Primer shall be applied to cut surfaces.
   b. Steel shapes which will not be finish painted under Division 9 shall be finish-painted under this Contract with two coats of exterior enamel of a color to be selected by the Engineer/Architect before equipment is mounted. Any finishes damaged during the equipment mounting process shall be repaired to the satisfaction of the Engineer/Architect.

3. Finishes.

   a. Shapes shall be cleaned and finished by a hot dip galvanizing process in accordance with ASTM A 123.
   b. Field cuts shall be thoroughly wire brushed and finished with brush applied cold process galvanizing in accordance with ASTM A 780.

2.3 FABRICATED SUPPORTS

A. **General**. Provide fabricated support assemblies constructed of structural shapes welded together to form a complete, secure, and durable assembly and finished appropriately to withstand the environment in which they are to be employed.

B. **Materials**. Provide structural steel angles, channels, and W-shapes hereinbefore specified, cleaned, but without other finish.

C. **Fabrication**

1. Steel shapes shall be assembled by full penetration welded connections. Welding shall be performed by a welder who has successfully passed the American Welding Society (AWS) welding qualification tests for AWS D1.1 "Structural Welding Code-Steel."
2. Welds shall be ground smooth and flush so as to present a noninterferring surface for equipment mounting. Disturbed areas around

welds shall be wire brushed (ground, if necessary) to remove slag and spall.

3. Entire assembly shall be phosphated, primed and finished with two coats of exterior enamel before installation. Enamel color shall be selected by the Engineer/Architect.

2.4 CONDUIT SEALS

A. **General**. Provide seals around conductors inside conduits and between conduits and sleeves/bored holes through which conduits penetrate concrete walls and floors.

B. **Materials**

1. Expanding Foam Seals. Provide two part silicone sealant which foams in place to fill voids between cables and conduits.

   a. Foam shall be UL listed as a fire barrier and shall be similar and equal to 3M 2001 RTV Foam. Prior to using this product, ensure that it will not adversely react with conductor insulation or sheath material.
   b. Provide a foam depth of at least one conduit trade size.

2.5 WALL/FLOOR SEALS

A. **General**

1. Provide seals around sleeves or conduits penetrating concrete walls which are below grade or water-bearing walls and concrete floors through which conduits pass from below grade.

B. **Materials**

1. Provide high strength malleable or ductile iron body and pressure clamp, hot dip galvanized, with Type 316 stainless steel hex head tightening bolts. Body shall include fins designed to prevent water from creeping along the outside of the body. The body shall fit over and seat against a sleeve of high strength, high impact plastic pipe or steel pipe with high organic zinc conductive epoxy coating. A neoprene O-ring shall be included between the body and sleeve to provide a seal between them. Two close fitting pressure rings of polyvinyl chloride (PVC) coated steel shall be located on each side of a neoprene grommet through which the entering conduit passes, which grommet is compressed by the pressure clamp as the tightening bolts are screwed into the body. Assembly shall be similar and equal to O-Z/Gedney FSK series.
2. Provide flanged conduit pipe mounted on the wall or floor over the hole requiring sealing. Secure with stainless steel expanding anchor type studs or adhesive anchor system similar and equal to Hilti HVA with stainless steel studs. Studs shall be the largest diameter which will fit through the predrilled holes in the conduit pipe flange; provide one stud per predrilled hole. Pipe and flange shall be 0.098 inch thick steel with hot dipped galvanized finish. Provide a fire resistant synthetic rubber (FRR) gasket between the flange and the wall to fill voids created by minor wall surface irregularities. Flanged conduit pipe shall be equal to

CDS Sealing Systems (CDS) F series with HFS series gasket. Provide an FRR plug to securely close the space between the inner wall of the flanged conduit pipe and the outside of the through passing conduit. Plug shall be serrated on its outer and inner walls and shall include a flat flange on one end to aid in insertion in the pipe. Plug in place shall have a pressure resistance of 15 psi at the base and 30 psi at the flange. Plug shall be manufactured by the flanged conduit pipe manufacturer for use with that product and shall be properly sized to perform its sealing function.

2.6 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Slotted Metal Angle and U-Channel Systems.

    a. B-Line (Cooper).
    b. Thomas & Betts.
    c. American Electric (Steel City).
    d. Unistrut Diversified Products.

2. Conduit Supports.

    a. Appleton.
    b. Cantex, Inc.
    c. Carlon.
    d. Crouse-Hinds.
    e. Killark.
    f. Raco, Inc.
    g. Robroy.
    h. Thomas & Betts Corp.

3. Fasteners and Anchors.

    a. Hilti.
    b. ITW Buildex.
    c. Ideal Industries, Inc.
    d. Rawlplug Co.

4. Seals and Fire-Stops.

    a. CSD Sealing Systems.
    b. Dow Corning.
    c. 3M.

5. Conductor and Cable Supports.

    a. B-Line Systems.
    b. Condux International, Inc.
    c. Kellems, Division of Hubbell, Inc.
    d. O-Z/Gedney.

e. Pass & Seymour/Legrand.
f. Red Seal Electric Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Install supporting devices** to fasten electrical components securely and permanently in accordance with NEC requirements.

B. **Coordinate with the building structural system** and with other electrical installations.

C. **For raceway supports comply with the NEC** and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Supports shall be secured to the surface upon which they are mounted with fasteners adequate to carry the present and any indicated future working loads by a safety factor of four times the total working load, defined as the ultimate load. When the ultimate load calculation, either in tension or shear of any fastener is less than 200 pounds, provide fasteners which will develop an ultimate strength of at least 200 pounds in either tension or shear, as applicable, for each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze type hangers.
5. Support individual suspended horizontal conduit runs on pipe hangers suspended on 3/8 inch steel rod from swivel type supports securely anchored to structure. Do not use spring steel clips or other attachments to suspended ceiling supports.
6. Secure conduit clamps to concrete or masonry walls with concrete screw anchors, stud type expansion anchors, drop-in two-piece anchors, or adhesive stud anchors as strength requirements dictate. Provide stainless steel anchors in damp or wet areas, areas subject to hose down, or out-of-doors. Provide clamp backs for conduit installed on damp or wet walls and for all aluminum conduit on concrete or masonry walls.
7. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
8. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
9. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
10. Raceway supports shall be provided as required by the NEC and installed as recommended by NECA.

D. **Install vertical conductor supports** simultaneously with installation of conductors.

E. **Miscellaneous Supports.** Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. **In open overhead spaces**, cast boxes with hubs threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 2 feet from the box.

G. **Support duct banks entering building**, manholes, handholes, and other structures as shown on the drawings.

H. **Install sleeves in concrete slabs** and walls and all fire-rated assemblies.

I. **Seal all sleeves penetrating concrete** water-bearing walls or exterior walls below grade with mechanical seals. In new construction, cast seals into walls or floors. Provide surface mounted mechanical seals over holes cut in existing below grade walls.

J. **Seal the interior of all conduits** entering from below grade with seals as specified. Provide similar seals for conduits in existing water-bearing walls.

K. **Do not use wood screws** except in construction made of wood. Wood screws shall be round head or lag type with electrogalvanized or hot dip galvanized finish.

L. **Provide No. 8 or larger sheet metal screws** into metal studs in drywall construction. Do not use toggle bolts in drywall ceilings or walls.

M. **Provide fire-stops as specified around electrical work** penetrating fire rated assemblies. Install in accordance with the standard UL drawing for the greater fire resistance at the barrier.

N. **Provide supports fabricated from structural steel** or aluminum shapes as detailed on the drawings or as required to support equipment.

O. **Provide supports for luminaires mounted** on the bottom of suspended ceilings. Supports shall be constructed of lightweight U-channel spanning at least two lathers channels or main grid rails with 1/4-inch threaded rod through the ceiling system into the four corners of fluorescent or high intensity discharge (HID) fixtures. Provide a minimum of two 1/4-inch threaded rods to support smaller ceiling surface mounted incandescent or parallel lamp (PL) fluorescent fixtures. Provide fixture stud and carrier to support flush outlet boxes in the ceiling treatment or tile from the U-channel.

P. **Provide stainless mounting hardware** for securing electrical equipment to perforated sheet steel.

Q. **The following supports and support methods** are specifically prohibited:

1. Strap iron.
2. Wire of any type.
3. Welding other than stud welding as specified.
4. Plastic ties.
5. Piggyback clamps (one conduit supported from another conduit or pipe).
6. Devices which depend upon spring tension to support conduit or to remain in place.
7. Power driven anchors.
8. Clip type devices to secure lighting fixtures to the bottom of lay-in style suspended ceiling grids.

3.2 TESTS

A. **Test pull-out resistance of one of each** type, size, and anchorage material for the following fastener types:

1. Concrete screw anchors.
2. Expansion anchors.
3. Toggle bolts.

B. **Provide all jacks, jigs, fixtures, and calibrated indicating scales** required for reliable testing. Obtain the Engineer/Architect approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

END OF SECTION

SECTION 26 05 33

RACEWAY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 12, "Wires, Cables, and Connectors."
4. Section 26 05 34, "Cabinets, Boxes, and Fittings."
5. Section 26 05 29, "Supporting Devices."
6. Section 26 05 53, "Electrical Identification."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to install raceways in accordance with the plans and as specified herein.

B. **Types.** Types of raceways specified in this section include the following:

1. Electrical metallic tubing.
2. Flexible metal conduit.
3. Intermediate metal conduit.
4. Liquidtight flexible metal conduit.
5. Underground plastic utilities duct.
6. Rigid metal conduit.
7. Rigid nonmetallic conduit.
8. Liquidtight flexible nonmetallic conduit.
9. Surface raceways.
10. Wireways.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with raceways in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Code (NEC). Components and installation shall comply with National Fire Protection Association (NFPA) 70 "National Electrical Code."
2. National Electrical Manufacturers Association (NEMA) Compliance. Comply with applicable requirements of NEMA standards pertaining to raceways.

3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, Electrical Testing Laboratories (ETL), or Canadian Standards Association (CSA).

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

1.8 SEQUENCING AND SCHEDULING

A. **Coordinate with other work**, including metal and concrete deck installation, wires/cables, boxes, and panels, as necessary to interface installation of electrical raceways and components with other work.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. **Electrical Metallic Tubing (EMT)**. Steel, hot dip galvanized conforming to American National Standards Institute (ANSI) C80.3 and UL 797.

B. **Rigid Steel Conduit**. Rigid steel, hot dip galvanized, threaded type conforming to Federal Specification (FS) WW-C-581E, ANSI C80.1 and UL 6.

C. **Intermediate Steel Conduit**. Rigid intermediate grade, hot dip galvanized conforming to FS WW-C-581E, ANSI C80.1, and UL 1242.

D. **Rigid Aluminum Conduit**. Rigid aluminum conduit conforming to ANSI C80.5.

E. **Flexible Metal Conduit**. FS WW-C-566 and UL 1. Continuous, spirally wound, interlocked galvanized strip steel.

F. **Liquidtight Flexible Metal Conduit**. Single strip, flexible, continuous, interlocked, and double wrapped steel; galvanized inside and outside; covered with liquidtight jacket of flexible PVC conforming to UL 360.

G. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. AFC.
2. Alflex Corp.
3. Allied Tube and Conduit.
4. Electri-Flex Company.
5. Robroy Industries, Inc.
6. Wheatland Tube Co.

2.2 NONMETALLIC CONDUIT

A. **Rigid Nonmetallic Conduit**. PVC, Schedule 40, 90 degrees Celsius (° C.), conforming to NEMA TC-2, UL 651, and NEC Article 347.

B. **Rigid Nonmetallic Conduit (Heavy Wall)**. PVC, Schedule 80, 90° C., conforming to NEMA TC-2, UL 651, and NEC Article 347.

C. **Liquidtight Flexible Nonmetallic Conduit**. Continuous spiral of hard PVC encapsulated with flexible PVC conforming to UL 1660.

D. **Electrical Nonmetallic Tubing**. PVC conforming to NEMA TC-13.

E. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Alflex.
2. Cantex Industries.
3. Carlon.
4. Electric-Flex.

2.3 CONDUIT FITTINGS AND ACCESSORIES

A. **General**. Provide conduit accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

B. **Conduit Bodies**

1. General. Provide conduit bodies of types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion resistant screws.
2. Rigid Metal. Threaded galvanized cast iron conforming to UL 514B and FS W-C-586D.
3. Hazardous Locations. Threaded galvanized cast iron approved for hazardous locations as identified on plans.
4. EMT. Set-screw type conforming to UL 514B.
5. Nonmetallic. PVC, molded solvent weld connector conforming to UL 514B.

C. **Locknuts**. Construct locknuts with sharp edge for digging into metal and ridged outside circumference for proper fastening.

D. **Bushings**. Metal, flared bottom, ribbed sides, set screw type grounding terminal and smooth rounded inner circumference.

E. **Conduit Hubs**. Threaded hub, metal, locknut/bushing, gasket.

F. **Rigid Metal Conduit Fittings**. Threaded cast malleable iron galvanized fittings conforming to FS W-F-408.

G. **EMT Fittings**. Steel, set screw type conforming to UL 514B.

H. **Flexible Metal Conduit Fittings**. Provide conduit fittings for use with flexible steel conduit of threadless hinged-clamp type.

1. Straight Terminal Connectors. One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
2. 45-Degree or 90-Degree Terminal Angle Connectors. Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

I. **Liquidtight Flexible Metal Conduit Fittings**. FS W-F-406, Type 1, Class 3, Style G. Galvanized malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated or noninsulated throat.

J. **Rigid Nonmetallic Conduit Fittings**. NEMA TC 3, mate and match to conduit type and material.

K. **Liquidtight Flexible Nonmetallic Conduit Fittings**. PVC, one piece body with PVC ferrule and neoprene gasket.

L. **Sealing Fittings and Products**

1. Mechanical Pipe Seals. See Section 26 05 29, "Supporting Devices."
2. Joint Sealants. Refer to Section 26 05 29, "Supporting Devices."
3. Provide gland type sealing bushings for interior conduit seals. See Section 26 05 29, "Supporting Devices."
4. Explosionproof Seals. Suitable for Class I, Division I, Group D atmosphere.

M. **Escutcheon Plates**. Chrome plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit conduit outside diameter. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

N. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering conduit fittings which may be incorporated in the work include, but are not limited to, the following:

1. Fittings.
   a. Adalet.
   b. Appleton Electric.
   c. Carlon.
   d. Condux International, Inc.
   e. Crouse-Hinds.
   f. Electri-Flex Company.

g. Killark Electric Mfg. Co.
h. Kraloy.
i. O.Z. Gedney.
j. Raco (Hubbell).
k. Robroy Industries.

2. Escutcheon Plates.
a. Chicago Specialty Mfg. Co.
b. Sanitary-Dash Mfg. Co.

2.4 WIREWAYS

A. **General**. Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.

B. **General Purpose Wireways**. NEMA 1 steel, front accessible, totally enclosed with bolted covers. Finish with rust-inhibiting coating and gray baked enamel finish. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

C. **Oiltight Wireways**. NEMA 12, oiltight and dusttight steel with hinged gasketed cover, external latches, and flanged gasketed joints. Finished with gray enamel paint inside and outside.

D. **Watertight Wireways**. NEMA 4X, watertight, corrosion resistant stainless steel with hinged gasketed cover, screw clamps, and flanged gasketed joints.

E. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering wireways which may be incorporated in the work include, but are not limited to, the following:

1. American Electric.
2. B-Line Systems, Inc. (Copper).
3. Erickson Electric Equipment Co.
4. GS Metals Corp.
5. Hoffman (Enclosures).
6. Square D Company.

2.5 SURFACE RACEWAYS

A. **General**. For surface raceways provide sizes and channels as indicated. Provide fittings that match and mate with raceway.

B. **Metal Raceways**. Provide surface metal raceway constructed of galvanized steel with snap-on covers, with 1/8-inch mounting screw knockouts in base approximately 8 inches on center. Finish with manufacturer's standard prime coating suitable for painting. Provide raceways of types suitable for each application required.

C. **Nonmetallic Raceways**. Provide surface nonmetallic raceway with two piece construction, manufactured of rigid PVC compound with matte texture and

manufacturer's standard color. Raceway and system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics.

D. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

E. **Manufacturers**. Subject to compliance with requirements, provide products by the following:

1. Surface Metal Raceway.
   a. Allied Tube & Conduit.
   b. American Electric.
   c. B-Line Systems, Inc.
   d. Erickson Electrical Equipment Co.
   e. GS Metals Corp.
   f. Hoffman Co.
   g. Square D Co.
   h. The Wiremold Co.

2. Surface Nonmetallic Raceway.
   a. Anixter, Inc.
   b. Hoffman Co.
   c. Hubbell, Inc.
   d. Panduit Corp.
   e. Gardner Bender.
   f. The Wiremold Co.

PART 3 - EXECUTION

3.1 **EXAMINATION**. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Engineer/Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer/Architect.

3.2 **PREPARATION**

A. **General**. Field-bend conduit with benders designed for the purpose so as not to distort or vary the internal diameter. Cut conduits straight and properly ream to remove burrs.

B. **Metal Conduits**. Cut conduit threads deep and clean. Use of running threads at conduit joints and terminations is prohibited. Conduits installed underground, in slabs, or exterior shall have threads painted with a corrosion inhibiting compound before couplings are assembled. Aluminum conduits in contact with reinforced concrete shall be isolated by a bitumastic coating.

C. **Nonmetallic Conduits**. All PVC conduit joints shall be solvent welded to provide a watertight seal capable of sustaining an internal or external pressure of 25 pounds per square inch (psi) for 1 hour. PVC conduit shall be installed in a sand bed except PVC conduit encased in concrete.

D. **Install joint sealers** as specified in Section 26 05 29, "Supporting Devices."

E. **Install mechanical pipe seals** as specified in Section 26 05 29, "Supporting Devices."

3.3 **INSTALLATION - GENERAL**

A. **Complete the installation of raceways** before starting installation of cables and wires in raceways. All spare raceways shall be capped or plugged and include a pull wire. All metallic raceways shall be grounded.

B. **Install raceways as indicated** in accordance with manufacturer's written installation instructions, and in compliance with NEC and National Electrical Contractors Association (NECA) "Standards of Installation." Use roughing-in dimensions furnished by the supplier for all electrically operated units. Set raceways and boxes for connection to units only after the dimensions and locations clear with other trades. Install units plumb and level, and maintain manufacturer's recommended clearances.

C. **Mechanically assemble metal raceways** for conductors to form continuous electrical conductor, and make connections to electrical boxes, fittings, and cabinets to provide effective electrical continuity and a rigid mechanical assembly. Avoid the use of dissimilar metals throughout the system to eliminate the possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.

D. **Size conduits to meet the NEC** requirements, except no conduit shall be smaller than 3/4 inch for interior applications or 1 inch for exterior applications. The diameter of embedded conduits shall not exceed one-third of the slab or wall thickness.

E. **INSTALLATION - CONDUITS**

F. **Uses Permitted**

1. Use EMT only for concealed work in finished areas/offices with metal or wood stud construction.
2. Use flexible steel conduit in finished areas only and only from boxes to recessed lighting fixtures (6-foot maximum length) or for concealed work in existing walls.
3. Use liquidtight flexible steel conduit for the final 24 inches of connections to motors or equipment subject to movement or vibration.
4. Use Schedule 40 PVC conduit for chemical feed and chemical storage areas except for the analog signalwiring. All analog signal (4-20madc) wiring in such areas shall be within PVC coated galvanized rigid steel conduit.
5. Use galvanized rigid steel conduit for all interior installations (except classified area) not exposed to severe moisture or corrosive conditions. Foe classified area (Class I, DIV 1) use PVC coated rigid steel or an approved aluminum conduit.
6. Use Schedule 40 PVC for conduits located in slabs or under slabs.
7. Use Schedule 80 PVC conduit for all exterior underground installations. The transition from concrete encasement to riser shall be PVC-coated rigid steel conduit.
8. Use galvanized rigid steel conduit for all exterior aboveground installations.

G. **Routing**

1. General. Install exposed conduits and conduits above suspended ceilings, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or side walls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
2. Finished Areas. Conduits installed in finished areas of new construction shall be concealed in walls, in slabs, or above suspended ceilings. New conduits installed in existing finished areas shall be concealed where practical.
3. Concrete Slabs or Floors. Conduits shall not be embedded in concrete slabs or floors except where specifically shown.
4. Waterbearing Walls. Conduits shall not be embedded in waterproofed or waterbearing walls.
5. Underground. Install underground conduits a minimum of 24 inches below finished grade for circuits 600 volts or less and 36 inches for circuits above 600 volts. Concrete encased conduits shall have a minimum of 3 inches of concrete cover for circuits 600 volts and less and 4 inches for circuits above 600 volts. Wherever possible, make changes of direction with long sweep bends having a minimum radius of 2.5 feet. Conduits shall slope toward manholes or pull boxes and away from building with a pitch of not less than 3 inches in 100 feet. Provide a marker tape over all conduit runs as specified in Section 26 05 53, "Electrical Identification."

H. **Penetrations**

1. Exterior Walls. Conduits penetrating exterior walls of any structure (other than handholes, manholes, or pull boxes) below grade, at grade floors, or below grade floors shall be sealed to prevent moisture migration as specified in Section 26 05 29, "Supporting Devices." As close as practical to the penetration, install a junction box to allow for the installation of the interior conduit seal.
2. Slabs and Floors. Where PVC conduits are installed in slabs or floors, the transition from embedded to exposed shall be RMC or IMC. The metal conduit shall extend a minimum of 1 inch into the concrete. Where PVC conduits are installed below on-grade slabs or floors, the penetration shall be made with RMC or IMC.
3. Fire Rated Walls. Conduits penetrating fire rated walls, floors, and partitions shall be sealed with a fire rated sealant as described in Section 26 05 29, "Supporting Devices."
4. Roofs. Conduits shall penetrate roofs only where specifically shown on the plans. Roof penetrations shall meet the requirements of Section 07 51 17, "Roofing and Sheet Metal."
5. Finished Walls, Floors, and Ceilings. Where conduits pass through finished walls and ceilings, install escutcheons.

I. **Supports.** All conduits shall be supported as specified in Section 26 05 29, "Supporting Devices." Support all conduits entering structures as shown on the plans and as specified in Section 26 05 29. Provide reinforcing for concrete duct banks passing through backfilled area. Reinforcing shall extend a minimum of 5 feet beyond excavation.

J. **Fittings.** Install miscellaneous fittings such as reducers, chase nipples, three piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Use threaded fittings and conduit bodies for RMC and IMC. Install grounding type expansion fittings in raceways every 200 feet of linear run or wherever structural joints are crossed to allow for expansion and contraction. Draw up couplings and conduit sufficiently tight to ensure watertightness. Terminate EMT at all boxes with a connector, locknut, and bushing. Terminate RMC and IMC at NEMA 1 and NEMA 12 boxes with two locknuts, one inside and one outside, and a bushing. Terminate RMC and IMC at NEMA 3R, NEMA 4, and NEMA 4X enclosures and weatherproof equipment enclosures with conduit hub assemblies.

K. **Conduit Seals.** Provide explosionproof conduit seals where required by the NEC. Install approved sealing compound after conductor installation. Follow all manufacturer's installation practices.

3.4 INSTALLATION - WIREWAYS

A. **Uses Permitted**

1. Use watertight wireways in damp or wet interior areas and for all exterior areas.
2. Use oiltight wireways in dry process areas.
3. Use general purpose wireways in nonprocess areas.

B. **Routing**. Install wireways parallel or perpendicular to wall, floors, ceilings, or structural members.

C. **Supports.** All wireways shall be supported as specified in Section 26 05 29, "Supporting Devices."

D. **Fittings.** Install fittings that have been specifically designed and manufactured for their particular application.

3.5 **CLEANING**. During construction, protect partially completed raceway runs from entrance of dirt, moisture, and debris by means of suitable factory made duct plugs. After completion of installation, pull a mandrel through every conduit to check for alignment and clear passage. Use an iron shot mandrel with a diameter of 1/4 inch less than the nominal size of the conduit and with a length equal to the conduit diameter. The mandrel shall have a leather or rubber gasket slightly larger than the conduit opening. After testing the conduits with the mandrel, pull a stiff brush through each duct until it is clear of any particles of earth, sand, or gravel, then install plugs until wire is to be pulled. Clean existing ducts to be used for new cable in the same manner as noted above.

3.6 FIELD QUALITY CONTROL

A. **Nonmetallic Conduit Leak Test.** A test of system integrity shall be conducted of underground conduits by a low-pressure air test (3.0 to 5.0 psi) after the system is installed and cemented joints are set. Plug and block ends to prevent movement prior to pressurization. Check for leaks with a soap solution. NOTE: Low-pressure air can cause high-thrust loads and caution must be observed.

END OF SECTION

SECTION 26 05 34

CABINETS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 33, "Raceways."
4. Section 26 05 29, "Supporting Devices."
5. Section 26 05 26, "Grounding."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install cabinets, boxes, and fittings in accordance with the plans and as specified herein.

B. **Types of cabinets, boxes, and fittings** specified in this section include the following:

1. Outlet and device boxes.
2. Pull and junction boxes.
3. Floor boxes and service fittings.
4. Cabinets.
5. Hinged door enclosures.
6. Boxes for hazardous locations.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install cabinets, boxes, and fittings in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Underwriters' Laboratories, Inc. (UL) Listing and Labeling**. Items provided under this section shall be listed and labeled by UL.

C. **National Electrical Code (NEC) Compliance**. Components and installation shall comply with National Fire Protection Association (NFPA) 70 "National Electrical Code."

D. **National Electrical Manufacturers Association (NEMA) Compliance**. Comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

1.4 **SUBMITTALS**

A. **General**. Furnish manufacturer's product data, test reports, and material certifications.

B. **Shop Drawings**. For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Store cabinets, boxes, and fittings** in clean dry space. Protect products from weather, damaging fumes, construction debris, and traffic.

1.7 **SPECIAL WARRANTY**

Not used.

1.8 **DEFINITIONS**

A. **Cabinets.** An enclosure designed either for surface or for flush mounting having a frame, or trim in which a door or doors may be mounted.

B. **Device Box**. A box designed to house a receptacle or a switch.

C. **Enclosure**. A box, case, cabinet, or housing for electrical wiring or components.

D. **Hinged Door Enclosure**. An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.

E. **Outlet Box**. A wiring enclosure where current is taken from a wiring system to supply utilization equipment.

F. **Wiring Box**. An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or of switches for controlling electrical circuits.

PART 2 - PRODUCTS

2.1 **OUTLET, DEVICE, AND WIRING BOXES**

A. **Metal Outlet, Device, and Wiring Boxes**

1. Conform to UL 541A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.
2. Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be flat-rolled code gauge galvanized steel with stamped knockouts, threaded screw holes, and accessories suitable for each location including mounting brackets and

straps, cable clamps, exterior rings, and fixture studs. Device boxes shall be minimum of 3-1/2 inches deep.

3. Provide cast iron boxes of iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices, and closure plugs. Device boxes shall be minimum of 2-1/2 inches deep. Outlet boxes shall be minimum of 1-1/2 inches deep.
4. Provide explosionproof boxes conforming to UL 886, "Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations," listed and labeled for use in the specific location classification, and with the specific hazardous material encountered. Conduit entrances shall be integral threaded type.

B. **Nonmetallic Outlet, Device, and Wiring Boxes**

1. Conform to NEMA OS 2, "Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports," and UL 514C, "Nonmetallic Outlet Boxes, Flush Device Boxes and Covers." Boxes shall be molded polyvinyl chloride (PVC) units of type, shape, size, and depth to suit location and application.
2. Provide boxes for concealed work with mounting provisions and wiring entrances to suit installation conditions and wiring method used.
3. Provide boxes for exposed work which are ultraviolet stabilized, nonconductive, high impact-resistant boxes with integrally molded raceway entrance hubs and removable mounting flanges. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching PVC material suitable for the application.

2.2 PULL AND JUNCTION BOXES

A. **General**. Comply with UL 50, "Electrical Cabinets and Boxes," for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. **General Purposes Boxes**. Painted sheet steel with stamped knockouts and with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

C. **Dusttight and Oiltight Boxes**. Painted sheet steel without knockouts and with welded seams and oil-resistant gasket. Rated NEMA 12.

D. **Raintight Boxes**. Painted galvanized steel, drip shield, with stamped knockouts in bottom only. Rated NEMA 3R.

E. **Weatherproof Boxes**. Type 316 stainless steel, welded seams, without knockouts. Stainless steel hardware, seamless gasket, cover clamps on all four sides. Rated NEMA 4X.

F. **Cast Aluminum Boxes**. Molded of copper-free aluminum, with gasketed cover and integral threaded conduit entrances.

G. **Cast Iron Boxes**. Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.

H. **Cast Nonmetallic Boxes**. Ultraviolet stabilized, nonconductive, high-impact-resistant PVC boxes with gasketed cover and integral mounting flanges.

I. **Explosionproof Boxes**. Cast metal boxes conforming to UL 886, "Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations," listed and labeled for use in the specific location classification, and with the specific hazardous material encountered. Conduit entrances shall be integral threaded type.

2.3 HINGED DOOR ENCLOSURES

A. **General**. Comply with UL 50, "Cabinets and Enclosures," and NEMA ICS6, "Enclosures for Industrial Control and Systems."

B. **General Purpose Enclosures**. Constructed of 14-gauge sheet steel with continuous welded seams. Doors shall be hinged directly to cabinet and removable, with 3/4-inch flange around all edges, shaped to cover edge of boxes. Provide three-point handle-operated latch with key lock. Enclosure greater than 36 inches in width shall have two doors. Provide a painted removable internal mounting panel for component installation. Enclosure shall be rated NEMA 1 and shall be painted American National Standards Institute (ANSI) 61 gray.

C. **Dusttight and Oiltight Enclosures**. Constructed of 14-gauge sheet steel with continuous welded seams. Doors shall be hinged directly to cabinet and shall be removable, with 3/4-inch flange around all edges, shaped to cover edge of box. Oil resistant gasket. Provide three-point handle-operated latch with key lock. Enclosures greater than 36 inches in width shall have two doors. Provide a painted removable internal mounting panel for component installation. Enclosure shall be rated NEMA 12 and shall be painted ANSI 61 gray unless otherwise noted.

D. **Weatherproof Enclosures**. Constructed of 14-gauge Type 316 stainless steel with continuous welded seams. Doors shall be hinged directly to cabinet and shall be removable. Rolled lip around door and cabinet. Watertight seamless gasket. Stainless steel door clamps. Provide three-point handle-operated latch with key lock. Enclosures greater than 36 inches in width shall have two doors. Provide a painted, removable internal mounting panel for component installation. Enclosure shall be rated NEMA 4X.

2.4 CABINETS

A. **General**. Comply with UL 50, "Electrical Cabinets and Boxes."

B. **Cabinet shall be constructed of sheet steel,** NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.

C. **Provide double doors for cabinets** wider than 24 inches. Telephone cabinets wider than 48 inches may have sliding or removable doors.

D. **Provide combination spring catch** and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.5 FLOOR BOXES

A. **Cast Iron Floor Boxes**. Fully adjustable, waterproof, with threaded raceway entrances, adjusting rings, gaskets, and brass floor plates. Where indicated, provide multisection boxes with individual hinged section covers and provide for a duplex receptacle under one or more of the covers.

B. **Steel Floor Boxes**. Sheet steel, concretetight, fully adjustable, with stamped knockouts, adjusting rings, and brass floor plates. Where indicated, provide multisection boxes with concealed individual section covers under a common flush floor plate. Provide for a duplex receptacle in one of the concealed section covers and a 1 inch diameter bushed opening in the other.

C. **Service Fittings for Floor Outlet Boxes**. Surface mounted horizontal, cast aluminum type, 3 inches high, suitable for finished spaces and finished in satin aluminum, except as otherwise indicated. Provide duplex receptacle or 1-inch bushed opening for telephone or other communications service as indicated. Equip fitting for attaching flat to floor box cover.

2.6 ACCESSORIES

A. **Corrosion Inhibitors**. All enclosures containing equipment, terminals, or splices shall have a vapor phase corrosion inhibitor. Provide two spares for each one installed.

2.7 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Adalet Enclosure Systems.
2. American Electric.
3. Carlon Divison of Lamson & Sessions.
4. Crouse Hinds.
5. Erickson Electrical Equipment Co.
6. Hoffman Enclosures.
7. Killark Electric Mfg. Co.
8. O.Z. Gedney.
9. Raco/Bell Division Harvey Hubbell.
10. Spring City Electrical Mfg. Co.
11. Square D Co.
12. Steel City/Thomas & Betts.

PART 3- EXECUTION

3.1 COORDINATION

A. **Coordinate installation of electrical cabinets**, boxes, and fittings with wire/cable, wiring devices, and raceway installation work.

3.2 INSTALLATION

A. **Uses Permitted**

1. Outlet Boxes.

    a. Use galvanized flat rolled sheet steel boxes in all dry interior locations unless otherwise noted.
    b. Use cast metal boxes in all locations exposed to weather or dampness.
    c. Use galvanized flat rolled sheet steel boxes in finished areas with framed construction.
    d. Use nonmetallic boxes in corrosive areas as designated on the plans.
    e. Use explosionproof boxes in hazardous areas as designated on the plans.
    f. Use cast metal boxes in all other locations. Each box with associated covers and fittings shall have a NEMA rating suitable for each location installed.

2. Pull and Junction Boxes.

    a. Use NEMA 12 boxes in all dry interior locations unless otherwise noted.
    b. NEMA 1 boxes in electrical rooms.
    c. Use NEMA 4X boxes in all other locations exposed to weather or dampness.
    d. Use general purpose boxes in finished areas with framed construction.
    e. Use explosionproof boxes in hazardous areas as designated on the plans.

3. Hinged Door Enclosures.

    a. Use NEMA 12 enclosures to house electrical equipment and controls in dry interior locations.
    b. Use NEMA 1 enclosures to house electrical equipment and controls in dedicated electrical rooms.
    c. Use NEMA 4X enclosures to house electrical equipment and controls in all other locations.

4. Cabinets.

    a. Use NEMA 12 enclosures to house electrical equipment and controls in dry interior locations.
    b. Use NEMA 1 rating for cabinets located in dedicated electrical rooms.
    c. Use NEMA 4X cabinets to house electrical equipment and controls in all other locations.

5. Floor Boxes.

    a. Use cast iron floor boxes on grade and wet locations.
    b. Use concrete tight steel floor boxes in all other locations.

B. **General**

1. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
2. Support and fasten items securely in accordance with Section 26 05 29, "Supporting Devices."
3. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than size indicated.
4. Remove sharp edges where they may come in contact with wiring or personnel.
5. Install boxes in locations which ensure ready accessibility to enclosed electrical wiring and avoid installing boxes back to back in walls where there would be less than 6 inches (150 millimeters [mm]) separation. Fasten boxes firmly and rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Aluminum boxes in contact with reinforced concrete shall be isolated by a bitumastic coating.
6. Provide electrical connections for installed boxes.

C. **Outlet, Device, and Wiring Boxes**

1. For outlets at windows and doors, locate close to window trim. For outlets indicated above doors, refer to plans for mounting height above finished floor and center outlets above the door opening except as otherwise indicated.
2. For column and pilaster locations, locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
3. For outlet boxes for locations in special finish materials for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone, or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.
4. Mount outlet boxes for switches and receptacles with the long axis vertical or as indicated. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.
5. For outlet locations on exterior face of exterior walls, all outlet boxes shall be recessed in the wall.
6. For ceiling outlets for fixtures, where wiring is concealed, use 4-inch round or octagon boxes 1-1/2 inches deep, minimum.
7. For cover plates for surface boxes, use plates sized to box front without overlap.

8. Protect outlet boxes to prevent entrance of plaster and debris.
9. For concrete boxes use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6 inch depth.
10. Install floor boxes in concrete floor slabs so they are completely enveloped in concrete except for the top. Where normal slab thickness will not envelop box as specified above, provide increased thickness of the slab. Provide each compartment of each floor box with grounding terminal consisting of a washer-in-head machine screw, not smaller than No. 10-32, screwed into a tapped hole in the box. Adjust covers of floor boxes flush with finished floor.

D. **Pull and Junction Boxes**

1. Install clamps, grips, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.
2. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
3. Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 314 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

E. **Cabinets and Hinged Door Enclosures**

1. Mount with fronts straight and plumb.
2. Install with tops 78 inches above floor.
3. Set cabinets in finished spaces flush with walls.
4. Use spacers to maintain 1/4-inch clearance from wall.

F. **Floor Boxes**. Install level and flush with finish flooring material.

3.3 GROUNDING

A. **Electrically ground metallic cabinets**, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box, or enclosure.

3.4 CLEANING AND FINISH REPAIR

A. **Upon completion of installation** and before devices and wiring are installed, remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions, and weld marks.

B. **For galvanized finish**, repair damage using a zinc-rich paint recommended by the manufacturer.

C. **For painted finish**, repair damage using matching corrosion-inhibiting touch-up coating.

END OF SECTION

SECTION 26 05 44

MANHOLES AND HANDHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 31 23 00, "Excavation, Backfill, and Embankment," for general requirements for excavation, backfill, and related items for manholes and handholes.
2. Section 03 30 00, "Cast-In-Place Concrete," for cast-in-place concrete requirements except as modified herein.
3. Section 07 10 00, "Waterproofing," for waterproofing of manholes and handholes.
4. Section 26 00 01, "Basic Electrical Requirements."
5. Section 26 00 02, "Basic Electrical Materials and Methods."
6. Section 26 05 29, "Supporting Devices."
7. Section 26 05 26, "Grounding."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to install manholes and handholes in accordance with the plans and as specified herein.

B. **Underground Work**. This section includes underground electrical work including the following:

1. Manholes.
2. Handholes.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with manholes and handholes in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Manufacturer Qualifications**. Manufacturers of precast manholes and handholes shall be firms regularly engaged in manufacturing factory fabricated manholes and handholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS

A. **General**. Furnish manufacturer's product data, test reports, and material certification as required.

B. **Submittals**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for accessories for manholes and handholes and miscellaneous components. Include:

   a. Frames and covers.
   b. Pulling eye assemblies.
   c. Pulling and lifting hardware.
   d. Bolting inserts.
   e. Cable stanchions, arms, and insulators.
   f. Sump frames and cover.

C. **Detail drawings and design calculations** for precast manholes and handholes including reinforcing steel. Calculations shall reflect the conditions of this project and shall conform to the latest edition of the applicable codes. Drawings shall bear the stamp of a registered professional structural engineer in the state of Ohio.

1.5 JOB CONDITIONS

A. **Subsurface conditions were investigated** during the design of the project. Reports of these investigations are available for informational purposes only. Data in the reports are not intended as representations or warranties of accuracy regarding continuity of conditions (between soil borings or test kits). The Owner will assume no responsibility for interpretations or conclusions drawn from this material.

B. **Existing Utilities**. Information on underground utilities and possible obstructions in the path of construction under this section was obtained through investigations during the design of the project. Reports of these investigations are available for informational purposes only. Data in the reports are not intended as representations or warranties of accuracy regarding conditions and locations. The Owner will assume no responsibility of interpretations or conclusions drawn from this information.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Store precast concrete units** at site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

B. **Lift and support precast concrete units** only at designated lifting or supporting points.

1.7 **SPECIAL WARRANTY**

Not used.

1.8 **DEFINITIONS**

A. **Manhole**. A below the surface enclosure or chamber, large enough for a person to enter, connecting with ducts, and affording facilities for installing, operating, and maintaining equipment or wiring.

B. **Handhole**. A below the surface enclosure in connection with ducts into which people reach, but do not enter, for the purpose of installing, operating, or maintaining equipment or wiring.

1.9 **SEQUENCING AND SCHEDULING**

A. **Coordination of the Work**. Coordinate layout and installation of manholes and handholes with final arrangement of ducts as influenced by actual final location of other utilities in the field. Coordinate elevations of duct and raceway entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and ensure duct runs drain to manholes and handholes and as approved by the Engineer/Architect.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Manhole/Handhole Hardware and Accessories**

1. Frames and covers shall be cast iron conforming to American National Standards Institute (ANSI) C2, "National Electrical Safety Code," Rule 323. Furnish with cast in legend, "Electric" or "Signal" as appropriate. Cover to frame bearing surfaces machined.

2. Pulling eyes in walls shall be eyebolt with rebar fastening insert. Two inch diameter eye, 1" x 4" long bolt. Working load embedded in 6 inch, 4,000 pounds per square inch (psi) concrete: 13,000 pounds minimum tension.
3. Pulling and lifting irons in floor shall be 7/8-inch diameter hot dipped galvanized, bent steel rod, stress relieved after forming, and fastened to reinforced rod. Exposed triangular shaped opening. Ultimate yield strength, 40,000 pounds shear, 60,000 pounds tension.
4. Bolting inserts for cable stanchions shall be flared, threaded inserts of noncorrosive, chemical resistant, nonconductive thermoplastic material. One-half inch internal diameter by 2-3/4 inches deep, flared to 1-1/4-inch minimum at base. Tested ultimate pull-out strength: 12,000 pounds, minimum.
5. Expansion anchors for installation after concrete is cast shall be zinc plated carbon steel wedge type with stainless steel expander clip 1/2-inch bolt size, 5,300-pound rated pull-out strength, and 6,800-pound rated shear strength, minimum.

6. Barriers shall be provided for voltage separation of electrical, telephone, and instrumentations cables.
7. Cable stanchions shall be hot rolled, hot dipped galvanized "T" section steel, 2-1/4-inch size, punched with 14 holes on 1-1/2-inch centers for cable arm attachment.
8. Cable arms shall be 3/16-gauge hot rolled, hot dipped galvanized sheet steel pressed to channel shape, approximately two 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any position on cable stanchions.
9. Cable support insulators shall be high glaze, wet process porcelain arranged for mounting on cable arms.

B. **Manhole and Handhole Moistureproofing**

1. Conform to Section 07 10 00, "Waterproofing."

C. **Precast Manholes and Handholes**

1. Factory-fabricated of reinforced concrete and in conformance with ANSI C 2, "National Electrical Safety Code (NESC)" and applicable requirements of ASTM C 478, "Specifications for Precast, Reinforced Concrete Manhole Sections." Manhole structure shall be designed in accordance with requirements of the American Concrete Institute (ACI) 318, "Building Code Requirements for Reinforced Concrete," and the American Association of State Highway and Transportation Officials (AASHTO) publication "Standard Specifications for Highway Bridges." AASHTO H20 highway loading shall apply with 30 percent loading added for impact.
2. Handholes, unless otherwise indicated, shall be 4' W x 4' L x 4' D and shall be constructed of precast concrete in two sections. The reinforced concrete shall utilize Grade 60 reinforcing bars and Type II cement with a concrete strength equal to 4,500 psi. Reinforcing shall be tied unless evidence of compliance with ASTM A 184, "Fabricated Deformed Steel Bar Mats for Concrete Reinforcement," is approved by Engineer prior to fabrication.
3. Manholes, unless otherwise indicated, shall be 6' W x 6' L x 6' D and shall be constructed of precast concrete in two sections. The reinforced concrete shall utilize Grade 60 reinforcing bars and Type II cement with a concrete strength equal to 4,500 psi. Reinforcing shall be tied unless evidence of compliance with ASTM A 184 "Fabricated Deformed Steel Bar Mats for Concrete Reinforcement" is approved by Engineer prior to fabrication.
4. Precast units consisting of interlocking, mating sections, complete with accessory items, hardware, and features as indicated including concrete knockout panels for conduit entrance and sleeve for ground rod.
5. Joint sealant for joints between precast sections shall be continuous extrusion of asphaltic butyl material compounded for the adhesion, cohesion, flexibility, and durability properties required for a permanent seal against the maximum hydrostatic pressures theoretically attainable at the installation location with the ground water level at grade.

D. **Extra Materials**

1. Furnish the following extra materials matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.

a. Cable stanchions, support arms, insulators, and associated fasteners in the quantity of 10 percent of those installed for actual use in this project.

2.2 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Precast Manholes and Handholes.

a. CDR Systems Corporation.
b. Christy Concrete Products, Inc.
c. Hartford Concrete Products, Inc.
d. Norwalk Concrete Industries.
e. Strongwell.
f. Oldcastle Precast.
g. Smith-Midland Corp.

2. Frames and Covers.

a. East Jordan Iron Works, Inc.
b. Campbell Foundry Co.
c. Neenah Foundry Co.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **Duct Entrances to Manholes and Handholes**. End bells spaced approximately 7 inches center to center for 4-inch ducts and varied proportionately for other duct sizes. The change from regular spacing to end bell spacing shall start 10 feet from the end bell and shall be made without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances.

B. **General**. Provide manholes/handholes of sizes, shapes, and locations as indicated. Determine final grading of ducts as influenced by possible adjustments in other utilities and surface features and discovery of underground obstructions before installing manholes/handholes. Obtain Engineer/Architect's approval for manhole/handhole installation adjustments necessitated by the above. Install

units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.

C. **Elevation**. Install manholes with rooftop 15 inches below finished grade, minimum. Install handholes with depth as indicated. Where indicated, cast handhole cover frame directly into roof of handhole and set roof surface 1 inch above grade.

D. **Drainage**. Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.

E. **Precast Access**. Install access to manhole/handhole through cast iron frame and cover. For manholes, use 30-inch-diameter cover except as indicated. Use 30-inch-diameter cover for handholes except use 24-inch-diameter covers for 2' x 2' handholes. Install precast concrete rings and seal with joint sealant as described in Part 2 of this specification. In addition, caulk all seams and joints inside and out. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

F. **Hardware.** Install removable hardware including pulling eyes, cable stanchions, cable arms, and insulators as required for installation and support of cable and conductors and as indicated.

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G. **Field Installed Bolting Anchors**. Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

H. **Install barriers for voltage separation** of electrical, telephone, and instrumentation cables.

I. **Grounding.** Provide grounding as specified in Section 26 05 26, "Grounding."

3.2 INSTALLATION OF PRECAST MANHOLES/HANDHOLES

A. **Install in accordance with ASTM C 891**, "Practice for Installation of Underground Precast Concrete Utility Structures," and manufacturer's instructions.

B. **Support units on a level bed of crushed stone** or gravel, graded from the 1 inch sieve to the No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. **Compact backfill as required** to set units securely in place. Backfill and grading shall be sloped to drain surface water away from access covers.

3.3 FIELD TESTING

A. **Grounding**. Test manhole grounding provisions to ensure electrical continuity of bonding and grounding connections. Make ground resistance test at each ground rod and submit a report of the results. Use an instrument specifically designed for ground resistance measurements.

3.4 CLEANING AND RESTORATION

A. **Clean Manholes**. Clean all internal surfaces of manholes including sump. Remove all foreign material.

B. **Restoration**. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work to their original condition. The restoration shall include all necessary topsoil, fertilizing, liming, seeding, sodding, sprigging, or mulching. All such work shall be performed in accordance with section "Grading and Seeding." Maintain disturbed surfaces. Restore vegetation in accordance with section "Grading and Seeding." Restore disturbed paving as indicated.

END OF SECTION

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SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 09 90 00, "Painting," for related identification requirements.
2. Section 26 00 01, "Basic Electrical Requirements."
3. Section 26 00 02, "Basic Electrical Materials and Methods."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to perform the work in accordance with the plans and as specified herein.

B. **This section includes identification** of electrical materials, equipment, and installations. It includes requirements for electrical identification components including, but not limited to, the following:

1. Buried electrical line warnings.
2. Identification labeling for raceways, cables, and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with electrical identification in compliance with applicable requirements of governing agencies having jurisdiction, in accordance with these plans, and as specified herein.

B. **National Electrical Code**. Provide warning signs where required by National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC)."

C. **American National Standards Institute (ANSI) Compliance**. Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections:

1. Product data for each type of product specified.
2. Schedule of identification nomenclature to be used for identification signs and labels.
3. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Box, Conduit, and Raceway Identification

1. Adhesive Labels. Preprinted, flexible, self-adhesive orange vinyl labels with black legend. Legend covered with clear weather and chemical resistant coating.
2. Plastic Sleeves. Preprinted, pretensioned, snap-on, flexible, wraparound plastic sleeves with black legend. Sized to fit conduit diameter.
3. Plasticized Card Stock Tags. Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
4. Buried Line Warning Tape. Permanent, bright colored (orange), continuous printed, plastic warning tape not less than 6 inches wide by 4 mils thick with continuous metallic strip or core. Printed legend indicative of general type of underground line below.

B. Wire and Cable Identification

1. Colored Marking Tape. Self-adhesive vinyl tape not less than 7 mils thick and 3/4 inch wide.
2. Wire Labels. Self-adhesive wraparound labels with clear heat shrinkable jacket or permanent plastic heat shrinkable labels. Preprinted legends.
3. Aluminum Face Card Stock Tags. Weather resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, and laminated with moisture resistant acrylic adhesive. Preprint legend to suit the application and punch for tie fastener.
4. Aluminum Wraparound Marker Bands. Bands with stamped or embossed legend and slots or ears for permanently securing around wires, cables, or groups of wires. Four millimeter (mm) thick sheet aluminum.

C. **Nameplates and Signs**

1. Laminated Plastic. Engraving stock plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engrave legend in black letters on white face unless otherwise noted and punched for mechanical fasteners.
2. Metal Backed Butyrate. Weather-resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gauge, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.
3. Brass or Aluminum Tags. Metal tags with stamped legend, punched for fasteners. Dimensions: 2 inches by 2 inches by 19 gauge.

D. **Accessories**

1. Fasteners. Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.
2. Cable Ties. Fungus inert, self-extinguishing, one piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-pound minimum tensile strength, and suitable for a temperature range from minus 40 degrees Fahrenheit (^{o} F.) to 185 ^{o} F. Provide ties in specified colors when used for color coding.

2.2 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. American Labelmark Co.; Labelmaster Subsidiary
2. Brady Corp.
3. Carlton Industries, Inc.
4. Champion American, Inc.
5. Emed Co., Inc.
6. Grimco, Inc.
7. Ideal Industries, Inc.
8. Kraftbilt.
9. LEM Products, Inc.
10. Markal Corp.
11. National Band and Tag Co.
12. Panduit Corp.
13. Radar Engineers.
14. Seton Identification Products
15. Standard Signs, Inc.

PART 3 - EXECUTION

3.1 **APPLICATIONS**

A. **Conduits**

1. Over 600 Volts. Identify by words "DANGER: HIGH VOLTAGE" painted in black letters 2 inches high, stenciled at 10-foot intervals over continuous orange background. The following areas shall be identified:

a. Exposed conduits or conduits concealed above suspended ceilings.
b. Wall or ceiling surfaces in unfinished spaces directly external to conduits concealed in walls or ceilings.
c. Floor area in unfinished spaces above conduits running in basement or ground floor slabs.

2. Underground Lines. Identify with warning tape in trench above conduits.

B. **Boxes**

1. Code Required Caution Signs. Self-adhesive labels indicating system voltage. Install on outside of box cover.
2. Circuit Identification. Self-adhesive labels indicating contained circuits.

C. **Wires and Cables**

1. Color Coding. Color code service, feeder, and branch circuit conductors as follows:

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange*
Blue	C	Yellow
White	Neutral	White
Green	Ground	Green

*Where not permitted by inspecting authority, use purple.

a. Use conductors with colored insulation or use colored marking tape for sizes 8 American Wire Gauge (AWG) and smaller.
b. Use colored cable ties for sizes larger than No. 8 AWG. Apply three ties spaced 3 inches apart at each terminal or splice point.

2. Circuit Identification. Use aluminum wraparound marker bands to identify feeders and branch circuits in manholes, handholes, and pull boxes.

3. Conductor Labeling. Use wire labels to identify conductors as follows:

a. Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
b. Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three circuit, four wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation. For control and communications/signal wiring, use color coding for wire/cable

marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

c. Match identification markings with designations used in panelboards, shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

d. Provide securely attached nameplates identifying all ground buses. Provide securely attached nametags to each accessible termination, attachment, or bonding location for each equipment grounding conductor, grounding electrode conductor, and bonding conductor.

D. **Signs**

1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to ensure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. For emergency operating signs, install engraved laminate signs with white legend on red background with minimum 3/8 inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
3. Provide code required signs for multiple main switches, for standby power systems, and, where required, for generator ground connection.

E. **Nameplates**

1. General. Provide equipment identification nameplates for each major unit of electrical equipment, including central or master units of each electrical system. This includes communication/signal/alarm systems unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the contract documents and shop drawings.

2. Provide 1-1/2-inch high engraved plastic laminated nameplates (2 inches high where two lines of text are required) with 1/2-inch lettering for the following:

a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Switchgear and switchboards.
d. Substations.
e. Motor control centers.
f. Motor starters.
g. Transformers.
h. Electrical room ground bus.
i. Battery racks.
j. Power generating units.

k. Fire alarm master station or control panel.
l. Security monitoring master station or control panel.
m. Disconnect switches.
n. Control panels.

3. Provide 5/8-inch-high engraved plastic laminated nameplates (1-inch high where two lines of text are required) with 1/4-inch high lettering for individual compartments of the following:

a. Substations.
b. Switchgear and switchboards.
c. Motor control centers.

4. Provide 5/8-inch-high engraved plastic laminated namplates (1-inch high where two lines of text are required) with 1/4-inch high lettering for the following:

a. Push-button stations.
b. Remote controlled switches.
c. Dimmers.
d. Control devices.
e. Light switches.
f. Downstream receptacles protected by an upstream Ground Fault Interrupter (GFI) receptacle. The nameplate shall indicate that the receptacle is supplied through a GFI receptacle and the location of the GFI receptacle.

5. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment. All code requirements for signage shall be met.

3.2 INSTALLATION

A. General

1. Lettering and Graphics. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
2. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC. Clean surfaces of dust, loose material, and oily films before applying.
3. Sequence of Work. Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
4. Install labels where indicated or at locations for best viewing without interference with operation and maintenance of equipment.

B. Painting

1. Clean surface of dust, loose material, and oily films before painting.
2. For galvanized metal, use single component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty, acrylic-resin block filler. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.

3. Apply one intermediate and one finish coat of orange silicone alkyd enamel.
4. Apply primer and finish materials in accordance with manufacturer's instructions.

C. **Buried Line Warning Tape**. During trench backfilling, for exterior underground power, control, signal, and communications cables and conduits, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines are installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

D. **Tape**. Apply colored, pressure sensitive plastic tape in half-lapped turns. Apply the last two turns of tape with no tension to prevent possible unwinding. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

E. **Metal Tags**. Attach metal tags with one piece self-locking nylon cable ties.

F. **Cable Ties**. Apply cable ties with a special tool or pliers; tighten for snug fit and cut off excess length.

END OF SECTION

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SECTION 26 05 73

SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

A. Also related: Section 26 00 01, Paragraph 1.9.

1.2 **DESCRIPTION OF WORK**

A. General. Provide short-circuit, protective device coordination and arc flash hazard studies as prepared by the electrical equipment manufacturer or an approved engineering firm, in accordance with the plans and specifications.

B. **This study shall include** all new distribution equipment supplied by the equipment manufacturer under this Contract, as well as all directly affected existing distribution equipment at the Owner's facility.

1.3 **QUALITY ASSURANCE**

A. **The Contractor shall prepare** an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E – Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed in accordance to the IEEE Std. 1584-2002 equations that are presented in NFPA 70E-latest edition, Annex D.

B. **Qualifications**

1. The short-circuit, protective device coordination and arc flash analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
2. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
3. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
4. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

C. **Computer Analysis Software**. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program or prior approved equal.

D. **References**. The Contractor shall use the following references:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

    a. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
    b. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
    c. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
    d. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
    e. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
    f. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

2. American National Standards Institute (ANSI):

    a. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
    b. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
    c. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
    d. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

3. The National Fire Protection Association (NFPA):

    a. NFPA 70 - National Electrical Code, latest edition
    b. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 **SUBMITTALS.** Submit the following package in accordance with Division 1 and this specification section.

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report and submitted along with the equipment shop drawings. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.

B. The report shall include:

1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.

5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
6. Details of the incident energy and flash protection boundary calculations.
7. Recommendations for system improvements, where needed.
8. One-line diagram.
9. Report shall be signed and sealed by a registered professional engineer and verified by the equipment manufacturer.

C. Arc flash labels shall be provided in hard copy only.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

Not used.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **STUDIES**

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.2 **DATA COLLECTION**

A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized shall include existing and proposed loads as shown on the Contract Documents.

D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 **SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY**

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

B. Minimum transformer design impedances shall be used when test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions.
2. Selected base per unit quantities.
3. One-line diagram of the system being evaluated.
4. Source impedance data, including electric utility system and motor fault contribution characteristics.
5. Tabulations of calculated quantities.
6. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Unit substation primary and secondary terminals.
4. Low voltage switchgear.
5. Motor control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.
8. Other significant locations throughout the system.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings.
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility's overcurrent protective device.
2. Medium voltage equipment overcurrent relays.
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
6. Conductor damage curves.
7. Ground fault protective devices, as applicable.
8. Pertinent motor starting characteristics and motor damage points, where applicable.
9. Pertinent generator short-circuit decrement curve and generator damage point.
10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE Std. 1584-2002 equations that are presented in NFPA 70E-latest edition, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system including 5KV and 480V systems (switchboards, switchgear, motor-control centers, panelboards, busway and splitters, motor disconnects, etc.) where work could be performed on energized parts.

C. The arc flash hazard analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will

assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE Std. 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6 REPORT SECTIONS

A. Input data shall include, but not be limited to the following:

1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
3. Reactor data, including voltage rating, and impedance.
4. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X”d), rated MVA, rated voltage, three-

phase and single line-ground contribution (for Utility sources) and X/R ratio.

5. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-Circuit Output Data shall include, but not be limited to the following reports:

1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

    a. Voltage
    b. Calculated fault current magnitude and angle
    c. Fault point X/R ratio
    d. Equivalent impedance

2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

    a. Voltage
    b. Calculated symmetrical fault current magnitude and angle
    c. Fault point X/R ratio
    d. Calculated asymmetrical fault currents

        1) Based on fault point X/R ratio
        2) Based on calculated symmetrical value multiplied by 1.6
        3) Based on calculated symmetrical value multiplied by 2.7

    e. Equivalent impedance

3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

    a. Voltage
    b. Calculated symmetrical fault current magnitude and angle
    c. Fault point X/R ratio
    d. No AC Decrement (NACD) Ratio
    e. Equivalent impedance
    f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
    g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:

a. Current transformer ratio
b. Current setting
c. Time setting
d. Instantaneous setting
e. Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:

a. Adjustable pickups and time delays (long time, short time, ground)
b. Adjustable time-current characteristic
c. Adjustable instantaneous pickup
d. Recommendations on improved trip systems, if applicable

D. Incident energy and flash protection boundary calculations

1. Arcing fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the electrical equipment manufacturer's field service engineer as required.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Engineer in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

A. The Contractor of the arc flash hazard analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. Warning labels shall be provided for both under normal operation and when the system is under maintenance switch mode.

D. The label shall include the following information, at a minimum:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy or energy range corresponding to reported Hazard risk category.
6. Working distance
7. Engineering report number, revision number and issue date.

E. Labels shall be machine printed, with no field markings.

F. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.
3. For each low voltage switchboard, one arc flash label shall be provided.
4. For each switchgear, one flash label shall be provided.
5. For medium voltage switches one arc flash label shall be provided

G. Labels shall be field installed by the contractor and field verified by the vendor's field engineer.

3.3 **ARC FLASH TRAINING**

A. The Contractor of the arc flash hazard analysis shall train the Owner's qualified staff (eight persons) of the potential arc flash hazards associated with working on energized equipment (minimum of two 6-hours days). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent. Provide hard copies of training material for the class attendees as required.

END OF SECTION

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SECTION 26 12 00

MEDIUM VOLTAGE TRANSFORMER

PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 13, "Medium Voltage Cable," for cable terminations to be made at transformers.
4. Section 26 05 53, "Electrical Identification," for signs associated with transformer installations.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install medium voltage transformers in accordance with the plans and as specified herein.

B. **This section includes** distribution and power transformers with medium voltage primaries. Types of transformers specified in this section include the following:

1. Pad Mounted Type.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install medium voltage transformers in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Field Testing Organization Qualifications. To qualify for acceptance, an independent testing organization must demonstrate, based on evaluation of organization submitted criteria conforming to American Society for Testing and Materials (ASTM) E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.
2. Electrical Component Standard. Components and installation shall comply with National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC)."
3. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Compliance. Comply with applicable requirements of ANSI/IEEE Standards including C2, "National Electrical Safety Code (NESC)."

B. **Qualifications**

1. Installer Qualifications. Engage an experienced installer of medium voltage electrical distribution equipment to perform the installation specified in this section. Submit certified evidence of such qualifications to the Owner's Representative.
2. Manufacturer Qualifications. Member firm of National Electrical Manufacturers Association (NEMA) who is regularly engaged in manufacturing transformers that comply with the requirements of these specifications and that have been used on at least five projects of similar size and scope as this project.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections:

1. Product data for each product specified.
2. Shop drawings for each transformer, including dimensional plans, sections, and elevations showing minimum clearances, installed devices, and materials lists.
3. Wiring diagrams from manufacturer differentiating between manufacturer installed and field installed wiring. Elementary control diagrams in ladder form.
4. Product certificates signed by manufacturer of transformers certifying that their products comply with the specified requirements.
5. Installer certificates signed by the Contractor certifying that installers comply with the requirements specified under "Quality Assurance."
6. Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

1.8 TOOLS, SUPPLIES AND SPARE PARTS

A. The transformers shall be furnished with all special tools necessary to disassemble service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

The Contract shall furnish the following minimum spare parts for each transformer.

No. Required	Description
1 set	Primary fuses of each size provided.
1 set	Lighting arresters for each type provided.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the Shop Drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Transformer, General

1. Provide medium voltage transformers which are factory assembled and tested, general purpose, air cooled, liquid filled, and having characteristics and capacities as indicated.
2. Windings shall be two winding type, copper, designed for operation with high voltage windings connected to a 3 phase, 3 wire and 4-wire, 60 hertz (Hz), grounded neutral system as shown on the drawings.
3. Sound level of transformers for this project shall be minimum of 3 decibels (db) less than NEMA TR 1 standard sound levels for transformer type and size indicated when factory tested in accordance with applicable ANSI standard. Audible sound level tests shall be added to routine factory tests performed on transformers for this project. (Note: NEMA Standard TR1 is available from NEMA for reference with regard to sound levels even though it has been rescinded as an overall transformer standard.)
4. Windings. Copper.

B. Pad Mounted Transformers

1. Comply with ANSI/IEEE C57.12.26 and with the following features and ratings.

2. Size: The size, rating and quantity, shall be as follows:

- Two (2) 750 KVA, three phase, 4,160V-480Y/277V
- Ten (10) 150 KVA, three phase, 4,160V-480Y/277V

3. Insulating Liquid. Mineral oil, conforming to ASTM D 3487, "Specifications for Mineral Insulating Oil Used in Electrical Apparatus," Type II, tested in accordance with ASTM D 117, "Guide to Test Methods and Specifications for Electrical Insulating Oils of Petroleum Origin."

4. Insulation Temperature Rise. 65° C.

5. Basic Impulse Insulation Level. 150 KV.

6. Full Capacity Voltage Taps. Four nominal 2.5 percent taps, two above and two below rated high voltage, with externally operable tap changer for de-energized use, padlockable, with position indicator.

7. Primary Fuses. Current limiting type in dry fuse holder wells, mechanically interlocked with oil switch to prevent disconnect under load.

8. High Voltage Terminals. Arranged for loop feed with 3 phase, four position, gang operated load break switch, open air, with hook stick operated handle in the primary compartment.

9. Surge Arresters. Comply with NEMA Standard LA 1, Distribution Class, supported from tank wall within high voltage compartment, one for each primary phase.

10. Separable Insulated Connectors. Insulated bushing, parking stand, feed through bushing, and dead front elbow type lightning arrester for each high voltage terminal. Provide three portable insulated bushings for parking energized load break connectors on parking stands.

11. The high voltage incoming line compartment shall be dead-front, and shall enclose the high voltage bushings, and provide for cabling from below. Dead-front primary bushings shall be universal bushing wells with dead front inserts or dead front, “feed thru” inserts as required. The compartment shall have a hinged door with a fastening device which is accessible only through the low voltage compartment and makes possible the use of a single padlock.

12. The Contractor shall furnish dead front, load break elbow cable terminators.

13. Accessories. Provide the following accessories:

    a. One inch drain valve with sampling device.
    b. Dial type thermometer.
    c. Liquid level gauge.
    d. Pressure vacuum gauge.
    e. Pressure relief device, self-sealing with indicator.
    f. Key interlock on HV compartment door.

2.2 **MANUFACTURERS**

A. **Manufacturers**. Subject to compliance with requirements, provide products by the following:

1. ABB Power Company Inc.
2. Cooper Power Systems
3. Eaton, Cutler Hammer
4. General Electric Co.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **Install** transformers and accessories in accordance with manufacturer's written installation instructions.

B. **Identify** transformers in accordance with Section 26 05 53, "Electrical Identification."

C. **Tighten** electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. **Ground** transformers and tighten connections to comply with tightening torques specified in UL Standard 486A.

E. **Ground** substation type transformers to ground bus to provide a maximum ground resistance at transformer location per specification Section "Field Quality Control," "Ground Resistance Maximum Values."

F. **Use** exothermic welded grounding connections for wire-to-wire and wire-to-rod grounding connections. Make exothermic welds in accordance with the manufacturer's written recommendations. Welds that puff up or show convex surfaces are not acceptable. No mechanical connectors are required at exothermic weldments.

G. **Arrange** and pay for the services of a factory authorized service representative to supervise the field assembly and connection of components and the pretesting and adjustment of transformer, components, and accessories.

H. **Perform the following preparations** upon completing installation of the system for tests:

1. Make insulation resistance tests for transformers.
2. Make continuity test for windings and remote alarm circuits.
3. Furnish a set of contract drawings to test organization.
4. Provide manufacturer's installation and testing instructions to test organization.

I. **Conform** to International Electrical Testing Association (NETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems," ANSI/IEEE Standard C57.90.

J. **Correct** deficiencies identified by tests and make ready for retest. Verify that the total system meets the specified requirements.

K. **Upon completion** of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish.

L. **Adjust** transformer taps to provide optimum voltage conditions at utilization equipment.

M. **Provide** final protection and maintain conditions in a manner that ensures protection of transformers from damage or deterioration until Substantial Completion.

N. **Arrange** and pay for the services of a factory authorized service representative to demonstrate transformers and accessories and training of Owner's staff.

O. **Train** Owner's staff in operation and maintenance for at least 1 day. Include both classroom training and hands on equipment operation and maintenance procedures. Training shall include:

1. Safety precautions.
2. Features and construction of project transformers and accessories.
3. Routine inspection and test procedures.
4. Routine cleaning.
5. Features and operation and maintenance of integral disconnect and protective devices.
6. Interpretation of readings of indicating and alarm devices.
7. Fuse selection.
8. Protective relay setting considerations.
9. Features, operation, and maintenance of separable insulated connector system.
10. Tap changing procedures.

P. **Schedule** training with Owner and Engineer/Architect with at least 7 days' advance notice.

END OF SECTION

SECTION 26 13 00

MEDIUM VOLTAGE DRAWOUT BREAKER SWITCHGEAR

PART 1 - GENERAL

1.1 SCOPE

A. **The Contractor** shall furnish and install metal-enclosed drawout breaker switchgear equipment as specified herein and as shown on the contract drawings. The switchgear shall be front accessible such that it can be installed against the wall and shall not require rear or side access for its maintenance, inspection, or operation.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Section 26 00 01, “Basic Electrical Requirements.”
2. Section 26 00 02, “Basic Electrical Materials and Methods.”
3. Section 26 05 13, “Medium-Voltage Cable.”
4. Section 26 05 53, “Electrical Identification.”
5. Section 26 09 13, “Power System Metering and Control.”
6. Section 26 36 00, “Automatic Transfer Controller.”

1.2 REFERENCES

A. **The medium voltag**e metal-enclosed switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows:

1. ANSI/IEEE C37.20.3 & C37.20.2
2. ANSI C37.04
3. ANSI C37.09
4. NEMA SG 4
5. NEMA SG 5
6. CAN/CSA-22.2 No. 31-04
7. NFPA 70 (National Electrical Code).
8. NSCE (National Electrical Safety Code)

B. **The entire assembly** shall be UL (Underwriters Laboratories) or listed.

1.3 SUBMITTALS

A. **Furnish the following manufacturer’s** product data. Test reports and materials in accordance with conditions of contract and Division 1 specification sections:

1. Master drawing index.
2. Bill of material.
3. Front view elevation.
4. Floor plan.
5. Top view.
6. Single line.
7. Schematic diagram.
8. Nameplate schedule.

9. Component list.
10. Conduit entry/exit locations
11. Assembly ratings including:
    a. Short-circuit rating.
    b. Voltage.
    c. Continuous current.
    d. Basic Impulse Level.
12. Major component ratings including:
    a. Voltage.
    b. Continuous current.
    c. Interrupting ratings.
13. Cable terminal sizes.
14. Product data sheets.

B. **Provide the following** additional information as required:

1. Busway connection.
2. Connection details between close-coupled assemblies.
3. Composite floor plan of close-coupled assemblies.
4. Electrical Schematic diagram.
5. Key interlock scheme drawing and sequence of operations.
6. Descriptive bulletins.
7. Product data sheets.

C. **Protective Devices Coordination.** The switchgear manufacturer shall furnish a complete electrical distribution system short circuit and protective devices coordination study. The Study shall include the utility company's protective devices, facility's switchgear main and feeder breakers in the distribution section. Graphic indication of coordination shall be furnished in the form of a composite drawing showing time-current curves of system protective devices. Time current curves of each protective device shall be provided. Maximum available three phase and ground fault values shall be shown on the curves. Instructions shall be provided with the switchboard for performance testing of the ground-fault protection system.

1.4 SUBMITTALS FOR CONSTRUCTION

A. **The following information** shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in paragraph 1.04.
2. Wiring diagrams.
3. Certified production test reports.
4. Installation information including equipment anchorage provisions.

1.5 QUALIFICATIONS

A. **The manufacturer of the assembly** shall be the manufacturer of the major components within the assembly.

B. **For the equipment specified herein**, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

C. **The manufacturer of this equipment** shall have produced medium voltage metal-enclosed and metal-clad switchgear equipment for similar functions for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 **DELIVERY, STORAGE AND HANDLING**

A. **Each switchgear** assembly shall be split into shipping groups for handling as indicated on the drawings or per the manufacturer's recommendations. All drawout elements must be shipped installed in their respective compartments. If any parts or restraints are added for shipping, those parts must be clearly identified. Clear instructions shall be included as to when and how those parts/restraints are to be removed during the installation. Any special cautions and care to be exercised prior to opening the packaging shall be noted outside the packaging. Shipping groups shall be bolted to skids and suitable for loading, unloading, and handling. Each shipping group shall be equipped with lifting provisions for handling by crane. Accessories shall be packaged and shipped separately.

B. **Equipment unloading**, handling, storage, and installation instructions shall be included with the packaging in such a manner that it can be easily located and accessed before unloading the equipment.

C. **Equipment shall** be handled and stored in accordance with manufacturer's instructions.

1.7 **OPERATION AND MAINTENANCE MANUALS**

A. **Equipment operation and maintenance manuals** shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. **Eaton / Cutler-Hammer products** have been used as the basis for design and to be carried under the base bid. Equal products of quantity, dimensions and operating functions and features by G.E., or Siemens may be acceptable as an alternate bid item if they comply with all requirements specified or indicated in the contract documents. The manufacturer of the switchgear shall also be the manufacturer of the circuit breakers. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

B. Alternate Bid Equipment
   1. General Electric Co.
   2. Siemens Energy & Automation, Inc.

2.2 **SWITCHGEAR AND CIRCUIT BREAKER RATINGS**

A. **The switchgear described** in this specification shall be designed for operation on a 5KV (4.16KV nominal), 3-phase, 4 wire, solidly grounded, 60 Hertz system.

The switchgear's physical dimensions cannot exceed those shown on contract drawings.

B. **The switchgear main** bus shall be rated 1200 amperes. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by fault currents equal to the close and latch rating of the circuit breakers. The short time short circuit current withstand capability of the switchgear busses shall be the same as that of the circuit breakers. The temperature rise of the bus and connections shall be in accordance with IEEE standard C37.20.3 and C37.20.2, and documented by design tests.

C. **Each circuit breaker** shall have the following ratings:

Rated Maximum Voltage	4.76kV
1-minute Power Freq withstand voltage	19kV rms
Impulse withstand voltage (BIL)	60kV Peak
Continuous Current	As shown on drawings
Rated Short-Circuit Current at Rated Maximum Voltage	30kA rms Sym.
Rated Voltage Range Factor K	1.0
Maximum symmetrical Interrupting and 2-Sec short-time current carrying capability	30kA rms Sym
Closing and Latching Capability	82kA peak
3-Phase MVA at rated maximum voltage	250
Rated Interrupting Time	3 Cycle

2.3 CONSTRUCTION

A. **The switchgear assembly** shall consist of completely metal-enclosed, dead front vertical sections requiring only front access for connection, maintenance and operation of the switchgear and containing various combinations of circuit breakers and auxiliaries of rating and type noted on the drawings or specified herein.

B. **The switchgear shall** be a metal-enclosed design incorporating the following requirements from IEEE standard C37.20.3 and C37.20.2.

1. Switchgear designed for use with removable switching and interrupting devices as described in C37.20.2.
2. Metal barrier in front of, or a part of, the circuit interrupting device to ensure that, when in the connected (operating) position, no primary circuits are exposed by the opening of the circuit interrupting device's compartment door.
3. Automatic shutters that cover primary circuit elements when removable element (circuit breaker, VT, CPT, or primary fuse) is moved to the test/disconnected position as described in C37.20.2.
4. Mechanical interlocks for proper operating sequence under normal operating conditions as described in C37.20.2.
5. Bare bus and connections as characterized in C37.20.3. Insulated bus bars and connections shall be used where necessary to meet specified voltage withstand ratings.
6. Metal-enclosed design per C37.20.3, plus metal barriers between primary circuits in cable pull-sections, or bus-transition sections.

C. **The switchgear shall be** front accessible such that it can be installed against the wall, and shall not require rear access for its maintenance, inspection, or operation. Primary bus joints and supports that are not accessible from the front are to be designed such that no maintenance is necessary for those joints or supports. All necessary access for owner's primary cable terminations, joining of main and ground bus joints at shipping splits, and termination of control wires shall be provided from the front or top of the switchgear. Access to primary cable terminals shall not require the removal of any primary or secondary devices. The switchboard dimensions shall not exceed those shown on the contract drawings.

D. **Access to any medium-voltage cable** or bus connection shall be through removable panels requiring the use of tools and shall be marked with caution signs to indicate the presence of energized conductors behind them.

E. **Switchgear design** shall allow safe installation and removal of all drawout elements into and from their compartments. No high voltage circuits shall be exposed to maintenance personnel when drawout element compartment doors are opened or drawout elements are removed from the compartment. No high voltage circuits shall be exposed when control compartment doors are opened. Clearly visible caution signs and warnings shall be placed on all removable covers or bolted panels provided for access to primary circuits and cables.

F. **All low voltage devices** and their associated control wiring shall be isolated by grounded metal barriers from primary circuits with the exception of short lengths of wires such as at instrument transformer and space heater terminals. Space heaters shall be supplied when noted on the drawings or specified herein.

G. **The following features** shall be supplied on every compartment containing a drawout vacuum circuit breaker:

1. The compartment front door shall be capable of being safely opened. Barrier all high voltage parts with grounded metal, to provide full access to the front of the circuit breaker control faceplate and all low voltage control and instrumentation devices.
2. The stationary primary high voltage contacts in each breaker compartment shall be silver-plated and recessed within insulating tubes. A metal safety shutter shall automatically cover those stationary high voltage contacts when the breaker is in the test or disconnected position or out of the cell. Provide provision for padlocking the shutters in an open position for inspection or in the closed position to prevent inadvertent contact with the stationary primary high voltage contacts, when the breaker is removed from its cell.
3. Each compartment and circuit breaker shall be provided with mechanical interlocks to prevent the insertion of a circuit breaker into the compartment with a higher frame size or interrupting rating.
4. Each circuit breaker shall have three positions within its compartment, with compartment door closed: Disconnected, Test, and Connected.
    a. In the DISCONNECTED position, no primary high voltage or secondary control wiring connections shall be made and the safety shutters automatically close over the stationary high voltage contacts in the compartment.
    b. The TEST position shall be same as the DISCONNECTED position, except secondary control wiring shall be connected so that the breaker can be opened or closed electrically or manually.

c. In the CONNECTED position, the circuit breaker shall be in the normal operating position inside the compartment, with safety shutters fully opened, and primary and secondary connections fully made. Provide a label or other marking on the compartment floor, visible when compartment door is opened, to indicate that the circuit breaker is fully connected.

5. Provide cell switches with one form -C contact for breaker position status. Two switches shall be provided in each circuit breaker compartment. One switch shall change its state when breaker is moved to connected position, and the other switch shall change its state when breaker is moved to test/disconnected position. When additional contacts are required for controls or interlocking, provide auxiliary relays as required.

H. **Provide the following interlocks** for each drawout circuit breaker to insure safe and proper operation:

1. It shall not be possible to engage levering crank and withdraw the breaker when the breaker is in the connected position and closed.
2. It shall not be possible to close the circuit breaker manually or electrically while it is being levered or while the breaker is in any position between the connected and the test/disconnected.
3. It shall not be possible to insert the circuit breaker into the connected position if the circuit breaker control wiring connector is not properly engaged with its compartment control wiring connector. Interlocking shall also be provided to prevent disconnection of circuit breaker control wiring connector (manually or automatically) while the circuit breaker is in the connected position or in any position between the connected and the test/disconnected.

I. **Each auxiliary drawout compartment** shall be provided with safety shutter to cover stationary high voltage connections when the auxiliary drawer is withdrawn from the connected position.

J. **Vertical section construction** shall be of the universal frame type using die-formed bolted and welded parts. All enclosing covers and doors shall be fabricated from steel whose thickness shall be equal to or greater than those specified in ANSI/IEEE C37.20.3.

K. **Width, depth, and height** of each vertical section containing circuit breakers or drawout auxiliary equipment shall not exceed those shown on the contract documents.

2.4 BUS

A. **All bare buses** shall be continuously tin plated copper. Insulated buses only need to be plated at the joints.

B. **Ground bus conductor** shall be tin plated copper and be directly fastened to a bare metal surface of each vertical section, and be of a size sufficient to carry the rated momentary and short time short circuit current of the switchgear assembly.

2.5 BUS SUPPORTING SYSTEMS

A. **Main bus** shall be supported utilizing a high strength glass polyester support. Bus support devices within vertical sections shall have either molded fins of highly track-resistant Aramid Nylon or be glass polyester type A-20 insulators

2.6 WIRING/TERMINATIONS

A. **All control, CT and VT** secondary wiring shall be minimum #14 AWG, type SIS or an equivalent, rated 600 volt, 90 degrees C. Wiring for logic-level and/or supervisory circuits shall use wire size and type as required by the circuit function or device termination.

B. **Provide sleeve type wire markers** on all control wiring at each termination. Each wire marker shall indicate wire identification as shown on three line and schematic diagrams.

C. **The switchgear manufacturer** shall provide suitable terminal blocks for secondary wire terminations. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams. Terminal blocks shall be provided for customer connections to other apparatus.

D. **One NEMA 2-hole terminal pad** per phase shall be provided for attaching contractor supplied power cable terminal lugs for a maximum of two conductors per phase of the sizes indicated on the drawings. Sufficient space shall be allowed for Contractor supplied electrical stress relief termination devices.

2.7 CIRCUIT BREAKER

A. **Circuit breakers** shall utilize vacuum interrupters for interruption and switching functions. The current transfer between the circuit breaker and primary circuits conductors in the compartment shall be via heavily silver plated and spring loaded copper finger cluster (primary disconnect) on the breaker, and rigidly mounted silver plated copper stabs within the insulated housing mounted on the compartment wall. The current transfer from vacuum interrupter moving stem to the primary disconnect cluster on the breaker shall be non-sliding type via heavily silver or tin plated flexible copper leaf conductors attached on each end.

B. **Each circuit breaker** shall be supplied with contact surface erosion (contact wear) indicator that requires no tools or measurements for the checking of the contact surface erosion.

C. **Each circuit breaker** shall be equipped with high-speed stored energy operating mechanism and shall permit open-close-open (OCO) operating sequence without recharging the closing springs.

D. **The breaker front panel** shall be removable when the compartment door is open for ease of inspection and maintenance of the mechanism.

E. **Each circuit breaker** shall be equipped with mechanical operations counter on the front of the breaker to provide record of the number of circuit breaker operations.

F. **Each circuit breaker** shall include contacts Open/Close and spring Charged/Discharged status indications on the front of the breaker.

G. **Each circuit breaker** shall be supplied with an auxiliary switch with 5 NO and 5 NC contacts. The switch shall be heavy duty, double break type with wipe type contacts. All unused contacts from this switch shall be wired out to terminal blocks for owner's use.

H. **Each Circuit breaker** within the switchgear shall be electrically operated. Energy required for closing and opening of the circuit breaker shall be provided by manual charging of springs. The spring charging handle shall be integral to the breaker and conveniently located on the front of the circuit breaker.

I. **Each circuit breaker** shall be supplied with Manual "ON" and "OFF" push buttons located on the front of the circuit breaker for opening and closing the breaker manually, without a need for external control power.

J. **Energy required** for closing and opening of the circuit breaker shall be provided by charging of springs by an electrical motor. Electrical closing/opening of the circuit breaker shall be accomplished by energizing spring release coil/shunt trip coil. Control voltage required for electrical operation of the breakers shall be derived from a control power transformer mounted within the switchgear and shall be 120VAC Close and AC capacitor trip.

K. **One control circuit cutout device** shall be provided and installed in the control compartment of each circuit breaker for control circuit isolation and short circuit protection.

L. **All circuit breakers** shall also be supplied with a spring charging handle located on the front of the circuit breaker for manually charging closing springs during an emergency or for maintenance. Manual "ON" and "OFF" push buttons shall be located on the front of the circuit breaker for opening and closing the breaker manually.

M. **Provide pad lockable** hinged plastic cover to limit access to Manual "OFF" pushbutton and completely prevent access to Manual "ON" pushbutton.

2.8 TRIP UNITS

A. **The switchgear manufacturer** shall furnish and install, in the metal-enclosed switchgear, the quantity and type of trip units and current sensors or protection relays and current transformers as indicated on the drawings and described hereinafter in this specification.

B. **Microprocessor Based Three-Phase** & Ground Overcurrent & Voltage Protection Trip System with metering and on-board display capability (Cutler-Hammer type Digitrip 1150V or equivalent) shall be provided for all breakers within switchgear.

1. The three-phase and ground overcurrent and voltage protection trip system shall consist of Cutler-Hammer Digitrip 1150V or equivalent trip unit, Type-V or equivalent current sensors and matching rating plug for the trip unit, and mechanical trip actuator. The trip unit shall be UL recognized, CSA approved, and carry CE mark.
2. The mechanical trip actuator assembly and the trip unit shall be installed on the circuit breaker. The trip unit shall be front accessible. The current sensors shall be installed over insulated bushings, one in each phase, in the primary circuit. The assembly of the bushings and current sensors

shall withstand rated impulse voltage of the assembly. Each trip unit shall have rating plug installed that is matched to the associated current sensor rating. Provide an additional rating label on the back surface of the compartment door as a reference to indicate the current sensor and rating plug ratings used for primary circuit associated with that compartment.

3. The current sensor rating for each circuit shall be as indicated on the drawings or specified hereinafter in this specification. The current sensors produce a secondary output current proportional to the load current. The current sensors and rating plug defines the maximum continuous current rating of the circuit breaker (In). The overcurrent protection functions of the trip unit shall be self-powered from the current flowing in the secondary of the current sensors. The trip unit shall continuously analyze the secondary current signals and, when preset current levels and time delay settings are exceeded, send an initiating trip signal to the trip actuator of the circuit breaker. The trip actuator shall cause tripping of the circuit breaker by providing the required mechanical force for the tripping. The circuit breaker mechanism shall automatically reset the trip actuator each time the circuit breaker opens.
4. The trip unit shall provide following ANSI/IEEE protection functions:
    a. 51/50 (time and instantaneous overcurrent) for each of the (3) phases
    b. 51/50N or 51/50G (time and instantaneous overcurrent) for ground
    c. 37 (phase loss, with adjustable time delay)
    d. 46 (current unbalance, with adjustable time delay)
    e. 27 (3-phase undervoltage, with adjustable time delay)
    f. 59 (3-phase overvoltage, with adjustable time delay)
    g. 81U (underfrequency, with adjustable time delay)
    h. 81O (overfrequency, with adjustable time delay)
    i. 47 (voltage unbalance, with adjustable time delay)
    j. 32 (reverse power, with adjustable time delay)

    The trip unit shall be microprocessor based that operates from secondary output of current sensors and external voltage transformers and provide true RMS sensing of each phase and ground, and suitable for application with 60 Hz systems. The ground protection shall be capable of being utilized in residual scheme, zero sequence scheme, or deactivated. The overcurrent protection functions of the trip unit shall be self-powered from the current flowing in the secondary of the current sensors. The auxiliary power required for voltage and frequency related protection and alarm functions shall be 120 Vac +/- 10%, and shall be derived from UPS module powered from a CPT within the switchgear lineup.

5. The phase and ground time-overcurrent response curves shall have selectable characteristics as follows:
    a. Phase Long Delay: I^2t, I^4t, IEEE Moderately Inverse, Very Inverse, or Extremely Inverse
    b. Phase Short Delay: FLAT or I2t
    c. Phase Instantaneous: FLAT or I2t

d. Ground Overcurrent: FLAT or I2t

Phase Long Delay protection shall have memory feature, when enabled, shall cause breaker to trip in progressively shorter time if the circuit breaker trips and recloses on repeated overload conditions. The memory feature shall reset when at least 10 minutes have elapsed between the overloads.

The trip unit shall have ground fault memory to protect loads in the event of a sputtering arc to ground. The ground protection shall remember the sputtering ground for up to ten (10) times the ground fault time setting to allow detection of the sputtering arcing faults. After the expiration of the memory time, the unit shall reset automatically.

The sensing current for Ground protection shall be derived from the residual connections of the phase sensors or a separate Eaton Type-V or equivalent zero sequence sensor as indicated on the drawings or specified herein after in this specification.

6. Trip unit shall accept secondary output of 110 or 120 V, derived from a set of external primary voltage transformers, connected in two line-to-line or three line-to-ground configurations. The primary voltage transformer ratio shall be programmable for correct display of measured primary voltages, power, and energy values.
7. The trip unit shall have a built-in 24-character alpha-numeric LED display to allow programming and viewing of settings, menus, trip and alarm logs, and real time metering data. All settings shall be programmable through use of appropriate buttons located on the front of the unit.
8. Trip unit shall be capable of displaying following meter values:
    a. Individual phase and ground currents in RMS amperes, real time
    b. Individual phase and ground currents in avg RMS ampere (5 min average)
    c. Individual phase and ground currents, maximum and minimum (since last reset)
    d. Line-to-Line Voltages – Vab, Vbc, Vca
    e. Forward/Reverse kW, kW Demand, and Max kW Demand
    f. KVA, kVA Demand, and Max kVA Demand
    g. Watt and VA demand, maximum W and VA demand
    h. Forward/Reverse kWh
    i. KVAh
    j. Total Harmonic Distortation for each phase current
    k. Individual harmonic currents up through 27th harmonic for each phase
    l. Power factor, minimum, maximum
    m. Frequency
    n. Circuit breaker operations count
    o. Metering accuracy shall be minimum:
        1) +/- 1% of full-scale (In) for currents for currents in the range of 5 to 100% of (In)
        2) +/- 3% of full-scale for voltages (full-scale is equal to VT primary voltage)
        3) +/- 4% of full scale for power and energy readings
9. The trip unit shall have programmable output contacts, designated as Relay contacts A, B, and C. The Relay contact A can be programmed and activated for one or more trip or alarm conditions or it can be

programmed for use as a pulse initiator for either kWh or kVAh functions to transmit kWh or kVAh pulses to an external counter. The Relay contact B can be programmed and activated for one or more trip conditions for use as blocking relay to prevent closing of the circuit breaker after a trip until the trip unit is reset. The Relay contact C can be programmed and activated and latched for one or more trip conditions.

10. Zone Interlocking
    a. The Phase Short Delay time overcurrent and Ground time overcurrent protection functions shall be capable of being zone interlocked between two or more trip units, to provide the fastest possible tripping for faults within the zone of protection of the circuit breaker and yet also provide positive coordination among all breakers in the system to limit power outage to only the affected part of the system. Zone Interlocking wiring shall be provided when indicated on the drawings or specified herein after in this specification. When Zone Interlocking is employed, a fault within the zone of protection of the circuit breaker shall cause the trip unit to simultaneously: trip the affected circuit breaker immediately, and send a signal to upstream trip unit to restrain from tripping immediately. The restraining signal shall cause the upstream trip units to follow their set coordination times, so that the service is only minimally disrupted while the fault is cleared in the shortest possible time.
11. The trip unit shall be provided with a green LED (for unit status) that blinks approximately once every second to indicate that the trip unit is energized and operating properly. The overcurrent functions of the trip unit shall become self-powered once the 3-phase load current through the circuit breaker exceeds approximately 10-12% of the current sensor rating or 1-phase load current exceeds approximately 30% of the current sensor rating.
12. The trip unit shall be provided with representation of the time-current curve depicted on the faceplate of the unit that indicates the protection functions. The trip unit shall have battery backed-up LEDs strategically located in the related segment of the time-current representation to indicate mode of trip following an automatic trip operation. A battery test button shall be provided to confirm battery status and to reset the LEDs. All protection function of the unit shall be independent of the battery. The battery shall be used to for trip indication LEDs only. The battery shall be 3 volt, 1/3N lithium cell. It shall be front accessible and shall not affect operation of the trip unit or its protection function when installing/removing even when circuit breaker is in service.
13. The trip unit shall provide following data through its front panel display to help plan inspection and maintenance schedules of the circuit breaker and circuit it is protecting:
    -Total number of instantaneous and short delay trip operations by the circuit breaker since last reset
    -Total number of overloads (long delay trips) and ground fault trips since last reset
    -Total number of Close Operations by the circuit breaker since last reset
    -The last time the circuit breaker was operated (Opened or Closed or Tripped) with time and date
    -Maximum chip temperature in degrees C as seen by the trip unit

14. The trip unit shall have a test access port, protected by removable plexiglass cover, for interface with a hand held tester capable of testing trip elements of the trip unit, and mechanical trip assembly of the circuit breaker.
15. Provide one hand held tester
16. Provide communication cable (TripLink) to transfer settings from one trip unit to another via test access ports of the trip units.

C. **When shown on the drawings** or specified herein after, provide circuit breakers with Overcurrent Trip Switch (OTS). The switch shall operate when the circuit breaker has been tripped by the action of an integral trip unit. The switch shall have one Form-C contact wired out to terminal blocks, unless noted otherwise on the drawings. When the switch operates, its contact shall change state and remain in that state until the switch is manually reset.

2.9 PROTECTIVE RELAYS

A. **The switchgear manufacturer** shall furnish and install, in the metal-enclosed switchgear, the quantity, type and rating of protection relays as indicated on the drawings and described hereafter in this specification.

B. **Cutler-Hammer Type FP-6000**, microprocessor based multifunction protection and metering unit, ANSI device functions: 51/50, 51N/50N, 50BF, 25, 32, 46, 67, 27, 59, 47, 81-O, 81-U, and 86 shall be provided for both normal power and standby power main breakers. The relay shall be powered from internal power supply.

C. **Current and voltage input** for the protective relays shall be derived from conventional CTs and VTs connected in the primary circuits. Zero sequence CTs are to be included when shown on the drawings or specified herein after in this specification.

2.10 AUXILIARY DEVICES

A. **Ring type current transformers** shall be furnished when required for protective relays and metering. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be adequate for the type of relay/meter burden connected to each CT. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

B. **Voltage and control power transformers** of the quantity and ratings shall be supplied as indicated on the drawings or as specified herein after in this specification. Voltage transformers shall be mounted in drawout drawers contained in an enclosed auxiliary compartment. Control power transformers up to 15 kV, 5 kVA, single-phase shall be mounted in drawout drawers. Rails shall be provided as applicable for each drawer to permit easy inspection, testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn.

C. **A mechanical interlock** shall be provided to require the secondary breaker to be open before the CPT drawer can be withdrawn.

2.11 **OWNER METERING**

A. **Provide current transformers** for metering as shown on the drawings.

B. **Provide voltage transformers** including primary and secondary protective devices for metering as shown on the drawings.

C. **Microprocessor Based Metering Device** shall be equal to C-H, PX-8000 Analyzer with Ethernet connectivity feature on both normal power main and standby power main breakers.

2.12 **ACCESSORIES**

A. **Provide a key interlock** on the circuit breaker to prevent circuit breaker from closing, when it is in locked position.

B. **Provide distribution class** surge arresters with ratings in accordance with manufacture's recommendations as shown on the drawings.

C. Provide Arc Flash maintenance mode and zone selective interlocking on main and feeder breakers.

2.13 **NAMEPLATES**

A. **Engraved nameplates**, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16-inch high, minimum. Furnish master nameplate giving information in accordance with IEEE Standard C37.20.2-1999, section 7.4.1 for each switchgear lineup. Circuit nameplates shall be provided with circuit designations as shown on purchaser's single-line diagrams.

B. **Control components** mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's three line and schematic diagrams.

2.14 **FINISH**

A. Prior to assembly, all enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically, and then fused on by baking in an oven. The coating is to have a thickness of not less than 1.5 mils. The finish shall have the following properties:

Impact resistance (ASTM D-2794)	60 direct/60 indirect
Pencil hardness (ASTM D-3363)	H
Flexibility (ASTM D-522)	Pass 1/8-inch mandrel
Salt spray (ASTM B117-85 [20])	600 hours
Color	ANSI 61 gray

2.15 **SPECIAL SWITCHGEAR CONFIGURATIONS**

A. **Automatic Transfer Control** – Two Breaker Automatic Transfer Control with Common Load Bus as per UL 1008 standards.

1. Provide the switch gear assembly with microprocessor-based automatic transfer control system for two (2) main breakers with a common load bus. The system shall consist of the two (2) breakers with electrical operators as herein specified, and an integrated microprocessor-based automatic transfer control system containing sensing devices, low voltage logic control, and auxiliary equipment, as indicated on the drawings and specified here. The automatic transfer control system, when placed in the "automatic" mode, shall automatically transfer the load bus circuit to the alternate power source upon failure of the preferred source.
2. The basic sequence of operation based upon two normally energized sources shall be as follows. Normal operation shall be with the preferred source main breaker closed and standby main breaker open. Upon detection of an undervoltage to the line side of the preferred main breaker and after a field adjustable time delay, that main breaker shall open and after an additional field adjustable time delay, the standby breaker shall close restoring power to the facility. Upon restoration of voltage to the line side of the preferred main breaker and after a field adjustable time delay the standby main breaker shall open and after a field adjustable time delay the preferred main breaker shall close.
3. The logic of the transfer shall function via a microprocessor controller equal to Cutler-Hammer type IQ ATC-600. The set points shall be field adjustable without the use of special tools. LED lights shall be included on the controller to show:
    a. Normal Source Available
    b. Emergency Source Available
    c. Normal Source Connected
    d. Emergency Source Connected
    e. Load Energized.
    f. Control Power UPS Low Battery.
4. A digital readout shall display each option as it is functioning. Readouts shall display actual line-to-line voltage, line frequency and timers. When timers are functioning, the microprocessor shall display the timer counting down. All set points shall be re-programmed from the front panel of the controller when it is in the program mode. In addition the controller shall display date, time and reason of last 16 transfers, set points of timers, voltage pickup and dropout set points. It shall be able to communicate onto a Cutler Hammer PowerNet monitoring system all values and historical data that are displayed locally, and have the capability to change settings.
5. The transfer system shall include the following:
    a. A time delay transfer from the normal power source to the standby power source and from the standby power source to the normal source, forcing a neutral position to ensure the load voltage has decayed before reconnecting to the source from which the load is to be fed (0 seconds to 30 minutes).
    b. A time delay to override a momentary power outage or voltage fluctuation (0 seconds to 120 seconds).
    c. A time delay for transferring from the standby power source to the normal power source (0 seconds to 30 minutes).
    d. A Form C relay contact that changes state when the power is available on the normal source.

e. A Form C relay contact that changes state when the power is available on the standby source.
f. A preferred source selection (Source 1 or Source 2, or none).
g. Electrical Interlocking shall prevent paralleling of two sources in manual mode.

6. Two (2) sets of three-phase "line side" voltage transformers (open delta for 5 kV or 15 kV) with primary fuses and secondary supplementary protectors to provide both sensing and control power.
7. The automatic transfer system shall contain:
   a. One (1) selector switch with automatic and manual positions.
   b. One (1) open-close control switch for manual electrical operation of each controlled breaker.
   c. One (1) pushbutton to initiate manual retransfer to preferred source when the IQ Transfer Controller is functioning in automatic mode and programmed for manual retransfer.
   d. Provisions to automatically transfer to either source when it is initiated (via dry contact) remotely from the plant wide SCADA system.

2.16 ACCESSORIES

A. **The switchgear manufacturer** shall furnish accessories for operation and maintenance, including:

1. One – Levering crank for moving the breaker between test and connected positions.
2. One –Lifting device for installation/removal of breaker to/from its compartment.

2.17 SPARE PARTS

A. 1 Digital solid state circuit breaker trip unit

B. 1 Rating plug for each rating

C. 1 Set of MV and LV control power fuses for PT's

D. 1 PT

E. 1 Set of indicating LED lights and lens

F. 1 Capacitor trip device for each rating

G. 1 Mechanism operated contacts

H. 1 Cell operated contacts

I. 1 Trip coil

J. 1 Close coil

K. 1 Set of current transformers for each rating

L. 1 Set of distribution class arrestors 6KV nominal

2.18 **BILLS OF MATERIAL**

A. The metal-enclosed switchgear **auxiliary section** for control and instrumentation shall include the following:

1. Voltage transformers.
2. Current transformers.
3. Control power transformers.
4. Automatic transfer controller and apparatus.
5. Additional requirements as shown on the plans and specified herein.

B. The metal-enclosed switchgear main circuit breaker section for control of **a main circuit breakers** shall include the following:

1. One – Electrically Operated Drawout power circuit breaker rated 1200 ampere.
2. Three – Current transformers, single secondary, ratio as shown on drawings.
3. One – FP-6000, or equivalent microprocessor based multifunction protection and metering unit, ANSI device functions: 51/50, 51N/50N, 50BF, 25, 32, 46, 67, 27, 59, 47, 81-O, 81-U, and 86].
4. One PX-8000 microprocessor-based metering system
5. One – Circuit breaker Control Switch with Red and Green indicating lights.
6. One – Circuit nameplate.
7. One – Set of compression lugs (factory supplied) with insulating boots for primary cable connections.

C. Each metal-clad switchgear feeder breaker section for control of a **feeder circuit breaker** shall include the following:

1. One – Electrically Operated Drawout power circuit breaker, rated current as shown on drawings.
2. Three - Current sensors, ratings as shown on drawings.
3. One –Zero sequence current sensor, ratio 50:1.
4. One - Digitrip 1150V or equivalent integral trip unit.
5. One – Overcurrent Trip Switch (OTS).
6. One - Circuit nameplate.
7. One – Set of compression lugs (factory supplied with insulating boots for primary cable connections.

PART 3 - EXECUTION

3.1 **FACTORY TESTING**

A. **The following standard factory tests** shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. Electrically operated circuit breaker shall be operated over the range of minimum to maximum control voltage
2. When circuit breakers are equipped with Digitrip 520V or 1150V integral trip units, functional operation of the trip units and breaker

tripping through trip actuator shall be verified by secondary current injection into the secondary circuits of the applicable current sensors.
3. Factory setting of contact gap
4. One (1) minute dielectric test per ANSI standards
5. Final inspections and quality checks.

B. **The following production test** shall be performed on the circuit breaker housing:

1. One (1) minute dielectric test per ANSI standards on primary and secondary circuits
2. Operation of wiring, relays and other devices verified by an operational sequence test
3. Final inspection and quality check.

C. **The manufacturer shall provide three** (3) certified copies of factory test reports.

D. **Factory tests** as outlined above shall be witnessed by the owner's representative.

1. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed.
2. The manufacturer shall include the cost of transportation and lodging for up to two (2) owner's representatives. The cost of meals and incidental expenses shall be the owner's responsibility.

3.2 FIELD QUALITY CONTROL

A. **The Contractor shall provide** the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of _five_ working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. **The Contractor shall provide three** (3) copies of the manufacturer's field start-up report.

3.3 MANUFACTURER'S CERTIFICATION

A. **The Contractor shall** provide a qualified factory-trained manufacturer's representative to certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. **The Contractor shall provide three** (3) copies of the manufacturer's representative's certification.

3.4 TRAINING

A. **The Contractor shall provide a training session** for up to five (5) owner's representatives for two normal workdays at a jobsite location determined by the owner.

B. **The training session** shall be conducted by a manufacturer's qualified representative and consist of instruction on the assembly of switches, circuit breaker(s), protective devices, and other major components.

3.5 FIELD ADJUSTMENTS

A. **The relays or trip units** shall be set/programmed in the field by:

1. A qualified representative of the manufacturer, retained by the Contractor in accordance with settings designated in a coordination study of the system as developed and determined by the switchgear's manufacturer.

3.6 FIELD TEST

A. **Perform high-potential test** of switchgear and accessories and such other tests and examinations as are needed to achieve specified objectives, including the following:

1. Perform mechanical and electrical operator tests. Check main and auxiliary contact alignment.
2. Check arc interrupter operation on load interrupter switches.
3. Verify key interlock operation.
4. Test insulation resistance on each phase to ground and from each phase to each other phase.
5. Test ac overpotential in accordance with applicable ANSI/IEEE standards.
6. Test contact resistance across each main contact step. Report contact resistance in excess of manufacturer's tolerances.
7. Test protective relays to determine pickup parameters. Verify accuracy of timing setting for three points on time dial curve.
8. Trip each circuit breaker by operating each associated protective relay.
9. Measure minimum pickup voltage of each trip and close coil.
10. Test arc chutes for losses in accordance with manufacturer's instructions.
11. Check integrity and insulation of ground and test device.
12. Verify operation of all auxiliary and emergency equipment.
13. Retesting. Correct deficiencies identified by test and completely retest switchgear. Verify by the system test that the total system meets the specified requirements.

3.7 INSTALLATION

A. **The switchgear** shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's recommendations and installation instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment. The equipment shall be suitably protected with space heaters connected until accepted by the Owner.

B. **Furnish and install** structural mounting channels in accordance with manufacturer's recommendations to provide proper alignment of the units.

C. **The equipment shall be** installed and checked in accordance with the manufacturer's recommendations. This shall include, but not be limited to:

1. Checking to ensure that the pad location is level to within .125 inches every three (3) feet in any direction.
2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
3. Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
4. Secure assemblies to foundation or floor channels.
5. Measure and record High-Pot readings phase-to-phase, phase-to-ground, and neutral-to-ground (four-wire systems only).
6. Inspect and install all circuit breakers in their proper compartments.

D. **Install the switchgear** to allow complete unit door swing required for unit removal. This is specifically required where a vertical section of switchgear is set next to a wall to the left of a switchgear section.

E. **The Contractor shall furnish** and install all conduit and wire required to provide main, tie, and feeder breaker positions (open, closed) and breaker "TRIPPED" signals as inputs to the plant control system.

3.8 PAINTING

A. **Prior to final completion of the work,** all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

3.9 RUBBER MATS

A. **A three foot wide rubber mat** shall be furnished and installed on the floor and in front of the switchgear assembly. The mat shall be long enough to cover the full length of the equipment line-up. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting.

END OF SECTION

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SECTION 26 18 39

MEDIUM VOLTAGE MOTOR CONTROL CENTER

PART 1 - GENERAL

1.1 **SCOPE**

A. **The Contractor** shall furnish and install the medium voltage motor starters in MCC lineup as specified herein and as shown on the contract drawings.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Section 26 13 00, “Metal Enclosed Medium Voltage Switchgear.”
2. Section 26 00 01, “Basic Electrical Requirements.”
3. Section 26 00 02, “Basic Electrical Materials and Methods.”
4. Section 26 05 13, “Medium-Voltage Cable.”
5. Section 26 05 53, “Electrical Identification.”
6. Section 26 09 13, “Power System Metering and Control.”

1.2 **REFERENCES**

A. **Medium voltage motor** starters shall be designed, manufactured, assembled and tested in accordance with the following standards:

1. ANSI/NEMA ICS-3- 1993 (R2000).
2. UL 347.
3. NFPA 70 (National Electrical Code).
4. NSCE (National Electrical Safety Code).

1.3 **SUBMITTALS**

A. **Furnish the following manufacturer’s** product data. Test reports and materials in accordance with conditions of contract and Division 1 specification sections:

1. Master drawing index.
2. Bill of material.
3. Front view elevation.
4. Floor plan.
5. Top view.
6. Schematic diagram.
7. Nameplate schedule.
8. Component list.
9. Conduit entry/exit locations
10. Assembly ratings including:
    a. Short-circuit rating.
    b. Voltage.
    c. Continuous current.
    d. Basic Impulse Level.
11. Major component ratings including:
    a. Voltage.
    b. Continuous current.
    c. Interrupting ratings.

12. Cable terminal sizes.
13. Product data sheets.

B. **Provide the following** additional information as required:

1. Busway connection.
2. Connection details between close-coupled assemblies.
3. Composite floor plan of close-coupled assemblies.
4. Key interlock scheme drawing and sequence of operations.

C. **Motor Protection Device Coordination.** The controller manufacturer shall furnish a complete motor protection device coordination study. The Study shall include the recommended parameters and settings of the device for proper protection of the motor and feeder assembly.

1.4 SUBMITTALS FOR CONSTRUCTION

A. **The following information** shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04 above, and shall incorporate all changes made during the manufacturing process.
2. Wiring diagrams.
3. Certified production test reports.
4. Installation information, including equipment anchorage provisions.

1.5 QUALIFICATIONS

A. **The manufacturer of the assembly** shall be the manufacturer of the major components within the assembly.

B. **For the equipment specified herein**, the manufacturer shall be ISO 9001 or 9002 certified.

C. **The manufacturer of this equipment** shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 DELIVERY, STORAGE AND HANDLING

A. **Equipment shall be handled and stored** in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.7 OPERATION AND MAINTENANCE MANUALS

A. **Equipment operation and maintenance ma**nuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Eaton / Cutler-Hammer medium voltage** MCCs with integral ADM load break switches have been used as the basic for design and to be carried under the base bid. Equal products of quantity, dimensions and operating functions and features by G.E., or Siemens may be acceptable as an alternate bid item if they comply with all requirements specified or indicated in the contract documents.

The manufacturer of the medium voltage MCC shall also be the manufacturer of the medium voltage starters and breakers. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

B. Alternate Bid Equipment
1. General Electric Co.
2. Siemens Energy & Automation, Inc.

2.2 RATINGS

A. **Starters shall** have an integrated interrupting rating with current limiting fuses of 400 MVA.

B. **When starters are grouped together** in a lineup, the entire assembly shall be suitable for application on a power system having a short-circuit capacity of 50KA.

C. **The vacuum contactor** shall have the following ratings:

7200V Max.	400 Amperes
Max. Interrupting Current (3 OPS)	8500 Amperes
Rated Current – Enclosed	400 Amperes
Rated Current – Open	400 Amperes
Short-Time Current	
30 Sec.	2400 A
1 Sec.	6000 A
8.7 ms (0.5 Cycle)	63 kA Peak
Mechanical Life	2.5 Million
Electrical Life at rated current	300,000
Impulse Withstand	60 kV (1.2 x 50 Micro Sec.)

2.3 CONSTRUCTION

A. **Isolating switch and contactor assemblies,** including current limiting fuses, shall be of the component-to-component design with a minimum amount of interconnecting cables. The isolating switch shall be easily removed from the enclosure by removing the pin securing the operating rod to the switch and then removing two bolts securing the removable portion of the switch. Line and load

cable terminations shall be completely accessible from the front.

B. **The isolating switch shall be an externally operated** manual three-pole drawout type, such that in the open position it grounds and isolates the starter from the line connectors with an isolating shutter leaving no exposed high-voltage components. Integral mechanical interlocks shall prevent entry into the high-voltage areas while the starter is energized and shall block accidental opening or closing of the isolating switch when the door is open or the contactor is closed. The isolating switch handle shall have provisions for padlocking in the open position. [The isolating switch shall have a mechanical blown fuse indicating device. The isolation switch shall be designed for a minimum of 10,000 operations.

C. **Current limiting power fuses** shall be provided with special fatigue proof elements that allow the elements to absorb the expansions and contractions created by the heating and cooling associated with severe cycling as is typical with motor starting. The fuses will include visible fuse condition indicators. The fuses shall incorporate special time/current characteristics for motor service allowing proper coordination with the contactor and overload relay for maximum motor protection. This coordination shall be such that under a low-fault condition the interrupting rating and dropout time of the contactor shall be properly coordinated with all possible fuse sizes to eliminate contactor racing. The power fuses shall be vertically mounted permitting easy inspection and replacement without starter disassembly.

D. **The vacuum contactor** shall be of the slide-out and magnetically-held design, rated 400 amperes with single-break high-pressure type main contacts with weld-resistant alloy contact faces. The vacuum contactor contact wear shall be easily checked with the use of a “go/no-go” feeler gauge.

E. **A built-in test circuit** shall be included to permit checking of the starter control and pilot circuit, with the high voltage de-energized and isolated, and the contactor in its normal position or in the drawout position. The control circuit shall be capable of being energized through a polarized plug connector from an external 115-volt supply while in the test mode.

F. **The low voltage control compartment** shall be isolated and barriered from the high voltage area and mounted on a panel with a separate low voltage access door. The low voltage control components shall be accessible by sliding the panel out of the low voltage control compartment. The low voltage compartment shall be painted white to increase visibility of components mounted inside the compartment.

G. **Each starter cell** shall contain a vertical and horizontal low voltage wireway.

2.4 **BUS**

A. **When starters are grouped together in a lineup**, the horizontal main bus shall be located in its own separate, 12-inch high enclosure and isolated from the starters. To allow for ease of maintenance or extension of lineups without disassembling starters, the main bus shall be front, top and side accessible.

B. **Starters shall be connected** by an insulated vertical bus.

C. **All bus bars shall be copper.** Bus shall be rated for 1200A continuous current.

D. **Provide a 1/4 x 2-inch ground bus** throughout the entire lineup. Ground bus shall also be supplied in upper compartments of 2-high starters and be bus connected to the ground bus supplied in the lower compartments.

2.5 **WIRING/TERMINATIONS**

A. **All control wire** shall be UL approved.

B. **Standard control wire** shall be 14GA, stranded, tin-plated, red, dual-rated type XLPE (3173) 125 degrees C, SIS 90 degrees C.

C. **Current transformer circuits** shall utilize #12 wire with the same characteristics as above. Provide shorting blocks for all current transformers.

D. **Provide "plug-in" terminal blocks**, rated 600 V, 50 A with "clamping collar."

E. **Wire markers** shall be a molded plastic "clip-sleeve" type.

F. **"Clamping-collar"** type terminals shall be used to terminate control wiring. Current transformer circuits shall be provided with ring-type terminals where applicable.

2.6 **STARTERS**

A. **The starters shall be designed** to accommodate motors of the size and type as shown on the drawings.

B. **The starters shall be non-reversing** to accommodate the following motor type:

1. Induction and Synchronous Motors, Solid-State, Reduced Voltage Start as shown on the drawings.

C. **The following equipment** shall be provided for the starter type indicated in Paragraph 2.6B.

1. Each induction and synchronous motor reduced voltage solid-state starter shall include the following equipment:
   a. Medium Voltage Section.
      1) One – Fixed portion isolating switch with shutter mechanism.
      2) One – Removable portion isolating switch with blown fuse indication.
      3) Three – Bolt-in Current-limiting power fuses.
      4) One – Bolt-in main run vacuum contactor assembly.
      5) One – Bolt-in shorting by pass vacuum contactor assembly.
      6) One – Bolt-in PFC capacitor vacuum contactor assembly (induction motor only)
      7) One – Roll-Out, three phase, heavy duty solid-state power stack assembly.
      8) One – Control circuit transformer. Size as required.

9) Two – Control circuit primary current limiting fuses.
10) One – Control circuit secondary fuse.
11) One – Run test circuit.
12) Four – Electrical interlocks.
13) One – Three-phase current transformer suitable for use with MP4000 and electronic meter.
14) One – Zero sequence ground fault current transformer where ground fault protection is specified.
15) All necessary controls and DC excitation devices for the synchronous motor operation.

b. Low Voltage Instrument Compartment.
1) One – Motor protection relay (MPR as specified in 2.10).
2) One – Set of control relays.
3) One – Set of control circuit terminal blocks.
4) Isolation switch viewing window to verify switch position.
5) One – Set of control circuit terminal blocks.
6) One – Microprocessor metering MP4000 package as specified in 2.11.
7) Momentary start/stop pushbutton.
8) ON/OFF pilot lights.
9) Elapsed time meter.
10) Two PT's.

c. The solid-state, reduced voltage controller shall be C-H, U.L. listed type MV801.Units using triacs or SCR/diode combinations shall not be acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt effects.

d. The control board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for all connections. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns.

e. The integral paralleling run bypass contactor shall energize when the motor reaches 90% of full speed and close/open under one (1) times motor current.

f. The solid-state power stack assembly shall be mounted on a roll-out truck for ease of maintenance. When the truck is removed, the load cables shall be easily moved to the line side stabs to allow full voltage starting in emergency situations.

g. Supply a bypass truck to allow full voltage starting when the soft start truck is removed from the cell.

h. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIP switch setting on the device keypad. Units using bimetal overload relays are not acceptable.

1)Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter.

2)The starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad.

3)The starter shall be capable of either an electronic or mechanical reset after a fault.

4)Overtemperature protection (on heat sink) shall be standard.

5)The starter shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. Provide a means to disable phase rotation protection via a DIP switch n the device keypad.

6)The starter shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50% current differential between any two phases is encountered. Provide a means to disable phase loss/unbalance protection via a DIP switch on the device keypad.

7)The starter shall provide protection against a motor stall condition as standard. Provide a means to disable stall protection via a DIP switch on the device keypad.

8)The starter shall provide protection against a motor jam condition as standard. Provide a means to disable jam protection via a DIP switch on the device keypad.

9)The starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal, and Overload).

2.7 MECHANICALLY-LATCHED CONTACTOR

A. **Mechanically-latched contactor**, where shown on the drawings, shall be provided. The contactor shall remain closed, if there is a loss of voltage or a reduced-voltage condition.

B. **Mechanically-latched contactor** shall be closed electrically from a local or remote CLOSE pushbutton, and tripped by a mechanical linkage to an externally operated manual trip device.

C. **An electrically-operated solenoid** shall be supplied to trip the contactor as indicated on the contract drawings.

2.8 MAIN SWITCHES/FEEDER SWITCHES (7.2KV MAX)

A. **Furnish, where shown on the contract drawings**, three-pole manually operated quick-make, quick-break load break switches or integrated metal enclosed breakers.

B. **The fixed-mounted switches** shall fit in one-half of a standard 90-inch high, 36-inch wide vertical structure, when supplied with 400 A or smaller fuses. Provide mechanical interlocks such that the switch door cannot be opened when the switch is on, and when the door is open the switch cannot be closed. A safety screen shall be provided behind the switch door.

1. The load break switch shall have the following ratings:

Maximum Voltage	5.5 kV
BIL Rating	60 kV
Continuous Current	600 Amperes
Interrupting Capacity	600 Amperes at 80% PF
Interrupting Capacity	80 Amperes at 10% PF
Momentary Current	40,000 10 cycles Asymmetrical (Amperes)
Momentary Current	25,000 4 seconds Asymmetrical (Amperes)
Fault Current Closing	40,000 Asymmetrical (Amperes)

2.9 TIE LOAD BREAK SWITCH (7.2KV MAX)

A. **Furnish, where shown on the contract drawings**, the tie load break switch fully integrated with the motor control center.

2.10 MP-4000 MOTOR PROTECTION RELAY

A. **Provide a definite purpose microprocessor-based** Motor Protective Relay (MPR) in each starter as where indicated on the drawings for protection, control and monitoring of the motors. The MPR shall be Cutler-Hammer type MP-4000 relay provided with C-H PXG 800A interface to provide Ethernet communication with plan wide SCADA system. The MPR shall meet UL 1053, CUL and CSA standards.

B. **The true rms current** into the motor shall be constantly monitored, and by means of a protective algorithm, separated into positive and negative sequence components. These components shall be used to determine the heating effects on the stator and rotor of the motor to provide maximum motor protection and utilization. The relay shall be capable of being connected by three-wire conductor or fiber optic to a remote Universal Resistance Temperature Detection Module (URTDM) located at the motor to monitor up to six (6) motor winding, four (4) bearing and one (1) auxiliary RTD inputs. The MPR shall integrate the temperature input data from the URTDM with the protective algorithm. The protective curve algorithm shall be adaptive based on the motor temperature as measured by the URTD. The protective algorithm shall provide faster trip times for higher temperatures providing maximum motor protection and shall operate with a longer trip time for lower temperatures allowing maximum motor utilization. The MPR shall provide the following protective functions:

1. Motor running time overcurrent protection (IEEE Device 49/51).
2. Adjustable instantaneous overcurrent protection (IEEE Device 50) with adjustable start delay in one-cycle increments.

3. Adjustable current unbalance protection (IEEE Device 46 -adjustable in percent unbalance).
4. Rotor protection.
5. Underload trip with start and run time delays (IEEE Device 37/2).
6. Jam trip with start and run time delays.
7. Auxiliary overtemperature protection with URTDM.
8. Stator protection with URTDM (IEEE Device 49).
9. Motor bearing over temperature protection with URTDM (IEEE Device 38).
10. Load bearing over temperature protection with URTDM (IEEE Device 38).

C. **Only the following settings** shall be needed to define the motor thermal protection curve.

1. Motor full load amperes (FLA).
2. Locked Rotor Current in percent of FLA.
3. Locked rotor stall time in seconds.
4. Ultimate trip current based on motor service factor.

D. **The following control functions** shall be provided by internal solid-state based timers or relays:

1. Incomplete sequence delay (IEEE Device 2/19).
2. Limitation on number of starts per time period in minutes (IEEE Device 66).
3. Anti-backspin time delay (IEEE 2).
4. Programmable transition relay based on current and/or time.
5. Time between starts.
6. Number of cold starts.
7. Mechanical load shedding and restore function with timers.
8. Zero speed switch input timer for use with long accelerating time motors.

E. **The MPR** shall have a real-time clock for time tagging of events, operations and history. The relay shall have quick and easy access to monitored values, view settings, motor history and motor log records. The relay shall monitor and display the following:

1. Motor currents: Average current (Iave), individual phase and ground current in primary amperes and percent of full load and percent phase unbalance.
2. Motor RTD: Individual winding, motor bearing, load bearing and auxiliary temperatures.
3. Motor: Percent I^2t (thermal accumulation), time until next start can occur, remaining number of starts, and time left on oldest start.

F. **The MPR shall be capable** of accommodating external current transformers with ranges from 10/5 through 4000/5 amperes. Provide three (3) current transformers sized per manufacturer's recommendations based on motor full-load amperes and service factor. Where ground fault protection is specified, it shall be from an independent measuring circuit that utilizes either a separate zero sequence current transformer (50/51G) or residual scheme utilizing the three-phase current transformers (50/51N). For zero sequence ground fault protection, provide 50/5-ampere zero sequence transformer.

G. **Two user-programmable** discrete inputs shall be provided for external control or trip functions. Programmable input functions shall be included for shutdown based on external contacts for incomplete sequence of operation and remote trip, remote reset, differential trip, motor stop, reset disable, zero speed switch or emergency override.

H. **The MPR** shall be capable of providing a 4 – 20 mA output signal proportional to either the average of the three-phase currents, hottest winding RTD temperature or I^2t level.

I. **The unit shall** draw its power from a control power transformer located in the starter.

J. **Provide separately mounted RTDM**, mounted near the motor, to provide up to six (6) stator RTDs, two (2) motor bearing RTDs, and two (2) load bearing RTDs and one (1) auxiliary RTD.

K. **The device shall have separate Form C (**NO/NC) Trip, two programmable Form C (NO/NC) Alarm and Auxiliary contacts. All contacts shall have ratings of 10-amperes at 115/240 Vac or 30 Vdc resistive. The alarm and auxiliary relay output contacts shall be programmable to operate from any internal protection function or from a discrete input signal such as differential trip or remote trip. All contacts shall be programmable to function in either a mode 1 (non-fail-safe) or mode 2 (fail-safe) operation. The device shall be capable of providing a 4 – 20 mA output signal proportional to one of the following user-selectable parameters:

1. Average of the three-phase currents.
2. Hottest winding RTD temperature.
3. I^2t level.

L. **The relay shall be capable** of monitoring electrical current, receiving commands from remote sources either by contact closures or digital data, giving commands by means of contact closure to the motor starters and other devices under its control. The MPR shall be capable of displaying information by alphanumeric display to the operator or by digital communication signals to a remote location.

1. The combination relay and operator panel shall be mounted on the door of the starter. Specific data entry to suit the actual motor application shall be programmed into the device by means of the operator panel pushbuttons.
2. Entered data shall be stored in non-volatile memory so as not to require battery backup. Non-volatile memory shall be capable of storing all setup information even after power failure, all monitored information at the time of a trip, and cause of trip even after power failure. Access to all programmed set points shall be restricted by means of a secured and sealed access cover.
3. Alphanumeric display shall read out (in English) complete description of all protective functions e.g., “instantaneous overcurrent” and all monitored and programmable data such as “percent of full load in amps” and “motor bearing temperature”.
4. The MPR shall be user-selectable as to being programmable while the motor is running or require a motor shutdown for programming. If configured for programming while the motor is running, the protection shall stay active while programming is based on previous settings. Upon

the user exiting the programming mode, the new settings shall take effect.

5. The MPR shall have a user-selectable emergency override feature to reset I^2t thermal accumulation and de-active start inhibit timers for emergency starting of the motor. The emergency override feature shall be capable of being activated from an access-restricted button, communications or via a contact input into the MPR.
6. The MPR shall provide a programmable control function for reduced voltage applications for the transition from reduced to full voltage starting. The transition shall be programmable based on current, time current, and time.

M. **The MPR shall provide** the following data logging and display capability for history including the date and time from when the history was last reset and counting began. The history shall include:

1. Resettable motor history for operational counter, run time, highest starting and running currents, highest percent phase unbalance, maximum winding, bearing and load RTD temperature, and number of emergency overrides.
2. Re-settable Trip history for number of trips for ground faults, overloads, instantaneous overcurrent, JAM, underload, phase unbalance, RTDs, phase reversal, incomplete sequence, remote differential, communication, starts exceeded, time between starts, and transition.
3. Re-settable Alarm history for number of alarms, for ground faults, overloads, JAM, underload, phase unbalance, RTDs, starts exceeded.
4. A permanent history record which cannot be reset shall include total trips, run time and operations count.
5. A log book including a chronological list of events or operations as detected by the MPR, such as, starts, stops, setting change, emergency override, trips, alarms or changes in the state of discrete inputs.
6. An event log providing detailed information on trips and alarms including phase and ground currents, percent phase unbalance, maximum RTD temperatures, and cause of trip or alarm.
7. A start log providing information on the four most recent starts including maximum phase, and ground starting current, maximum percent unbalance, time from start to transition, current at transition, and time from start to run or trip.

N. **The MPR** shall have a user-programmable armed/disarmed feature with alarm indication. The disarmed mode shall permit relay installation while the motor is running with the trip outputs blocked. The draw-out case shall have a spare self-shorting contact to allow for continuous motor running or relay removed alarm functions.

2.11 CUSTOMER METERING

A. **Microprocessor-Based Metering Package**

B. **Auxiliary Devices**

1. Provide fixed mounted potential transformers, fused-type, of the quantity and ratings as required or as indicated on the contract drawings
2. Provide window-type current transformers of the quantity and current rating as required or as indicated on the contract drawings. Current transformer accuracy shall be suitable for the connected burden

3. Provide an auxiliary control power transformer of the quantity and kVA rating as required.

2.12 **SPARE PARTS**

A. 1 Set of 3 Main Fuses 5KV for each rating

B. 1 Secondary Fuses

C. 1 400A Contactor Coil

D. 400A Aux Interlock 2NO 2NC

E. 400A Circuit Board

F. 3 Vacuum Bottle 400A

G. 1 Iso Switch 400A, Bolted Fuse

H. 1 Iso Switch 400A, Bolted Fuse w/Blown Fuse Indication

I. 1 Lower Fuse Mount, 400A, Bolt-In

J. 1 Lower Fuse Phase Barrier-Single Barrel, 400A

K. 1 Set of RVSS SCR control boards for each rating

L. 1 3-Phase pole unit for RVSS SCR for each rating

M. 1 3-Phase capacitor for each rating

2.13 **ENCLOSURES**

A. **Provide NEMA 1A gasketed enclosures** for indoor applications where shown on the contract drawings. The maximum dimensions shall not exceed those shown on contract drawings.

B. **Enclosures for the medium voltage starters** shall meet NEMA ICS-6 standards. Enclosure shall be NEMA 1, unless otherwise noted, completely front accessible, allowing for free-standing, against a wall, or back-to-back mounting.

C. **Provide a dedicated incoming line enclosure section** to accommodate the number and size of incoming cables as required.

D. **Structures shall be welded steel frame**, formed steel doors and side sheets, flat steel top and rear covers.

E. **Standard hardware** shall be grade 5, plated zinc-dichromate.

2.14 **NAMEPLATES**

A. **Nameplates** shall be 2-inch high x 2-1/2 inch wide, laminated black with white core.

B. **Unit nameplate and device marker lettering** shall be 3/16-inch high.

2.15 **FINISH**

C. **The finish for internal and external parts** shall consist of a coat of ANSI 61 (gray) thermosetting, polyester, powder paint applied electrostatically to pre-cleaned phosphatized steel and aluminum surfaces.

2.16 **ACCESSORIES**

D. **Provide a portable lifting device** for transporting contactor outside its compartment.

PART 3 - EXECUTION

3.1 **FACTORY TESTING**

A. **The following standard factory tests** shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. Wiring check.
2. Sequence of control circuits.
3. Dielectric Test (Hi Pot) per NEMA ICS 3 Part 2 at 2000 volts plus 2.25 times nominal voltage, for 60 seconds, phase-to-phase and phase-to-ground.

B. **The manufacturer** shall provide three (3) certified copies of factory test reports.

C. **Factory tests** as outlined above shall be witnessed by the owner's representative.

1. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed.
2. The manufacturer shall include the cost of transportation and lodging for two owner's representatives. The cost of meals and incidental expenses shall be the owner's responsibility.

3.2 **FIELD QUALITY CONTROL**

A. **Provide the services** of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and startup of the equipment specified under this section for a period of five working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. **The following minimum work** shall be performed by the Contractor under the technical direction of the manufacturer's service representative:

1. Megger bus.
2. Ground test.
3. Verify that all mechanical interlocks are functioning properly.

C. **The Contractor** shall provide three (3) copies of the manufacturer's field startup report.

3.3 MANUFACTURER'S CERTIFICATION

A. **A qualified factory-trained** manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. **The Contractor** shall provide three (3) copies of the manufacturer's representative's certification.

3.4 TRAINING

A. **The Contractor** shall provide a training session for five (5) owner representative(s) for two normal workday(s) at a job site location determined by the owner.

B. **The training session** shall be conducted by a manufacturer's qualified representative and include instructions on assembly, starters and other major components.

3.5 INSTALLATION

A. **The Contractor shall install** all equipment per the manufacturer's recommendations and the contract drawings.

B. **All necessary hardware** to secure the assembly in place shall be provided by the Contractor.

C. **Check all bolted connec**tions to assure that they are in accordance with the manufacturer's recommended torque requirements.

3.6 FIELD ADJUSTMENTS

A. Program the motor protective relays in accordance with the recommendations documented by the coordination study prepared by the MCC and starters vender.

3.7 FIELD TESTING

A. **Perform high-potential test** of MCC, starters and accessories and such other tests and examinations as are needed to achieve specified objectives, including the following:

1. Perform mechanical and electrical operator tests. Check main and auxiliary contact alignment.
2. Check arc interrupter operation on load interrupter switches.
3. Verify key interlock operation.
4. Test insulation resistance on each phase to ground and from each phase to each other phase.
5. Test ac overpotential in accordance with applicable ANSI/IEEE standards.
6. Test contact resistance across each main contact step. Report contact resistance in excess of manufacturer's tolerances.
7. Test protective relays to determine pickup parameters. Verify accuracy of timing setting for three points on time dial curve.
8. Trip each starter by operating each associated protective relay.
9. Measure minimum pickup voltage of each trip and close coil.

10. Test arc chutes for losses in accordance with manufacturer's instructions.
11. Check integrity and insulation of ground and test device.

B. **Verify operation** of all auxiliary and emergency equipment.

C. **Retesting.** Correct deficiencies identified by test and completely retest switchgear. Verify by the system test that the total system meets the specified requirements.

3.8 INSTALLATION

A. **The MCCs** shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer’s recommendations and installation instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment. The equipment shall be suitably protected with space heaters connected until accepted by the Owner.

B. **Furnish and install** structural mounting channels in accordance with manufacturer's recommendations to provide proper alignment of the units.

C. **The equipment** shall be installed and checked in accordance with the manufacturer's recommendations. This shall include, but not be limited to:

1. Checking to ensure that the pad location is level to within .125 inches every three (3) feet in any direction.
2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
3. Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
4. Secure assemblies to foundation or floor channels.
5. Measure and record High-Pot readings phase-to-phase, phase-to-ground, and neutral-to-ground (four-wire systems only).
6. Inspect and install all circuit breakers in their proper compartments.

D. **Install the MCCs** to allow complete unit door swing required for unit removal. This is specifically required where a vertical section of MCC is set next to a wall to the left of a MCC section.

3.9 PAINTING

A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

3.10 **RUBBER MATS**

A. A 3-foot-wide rubber mat shall be furnished and installed on the floor and in front of the MCC assembly. The mat shall be long enough to cover the full length of the equipment line-up. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting.

END OF SECTION

SECTION 26 22 00

LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 29, "Supporting Devices."
4. Section 26 05 53, "Electrical Identification," for signs associated with transformer installations.
5. Section 26 12 00, "Medium-Voltage Transformer," for power and distribution transformers with windings rated over 600 volts.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install general purpose and specialty dry-type transformers and voltage regulators with windings rated 600 volts and below, in accordance with the plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install transformers in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Underwriters' Laboratories, Inc. (UL). Equipment provided under this section shall be listed by UL and shall bear the UL label.
2. UL Compliance. Equipment shall comply with American National Standards Institute (ANSI)/UL Standard 506-1989, "Specialty Transformers"; Standard 1446, "Systems of Insulating Materials - General"; and Standard 1561, "Dry-Type General Purpose and Power Transformers," as applicable.
3. National Electrical Manufacturers Association (NEMA). Equipment provided under this section shall meet the requirements of NEMA Standard ST 1-1988, "Specialty Transformers (Except General Purpose Type)," or ST 20-1992, "Dry Type Transformers for General Applications," as applicable.
4. ANSI/Institute of Electrical and Electronics Engineers (IEEE) Compliance. Comply with applicable requirements of ANSI/IEEE Standards including C2-1993, "National Electrical Safety Code"; C57.12.80-1978, "Terminology for Power and Distribution Transformers"; C57.12.91-1979, "Test Code for Dry-Type Distribution

and Power Transformers"; and C57.15-1986, "IEEE Standard Requirements, Terminology, and Test Code for Step Voltage Regulators."

5. Electrical Component Standard. Components and installation shall comply with National Fire Protection Association (NFPA) 70, "National Electrical Code (NEC)," latest edition.
6. ANSI/IEEE C57.110-1986, "Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents."

B. **Qualifications**

1. Manufacturer Qualifications. Member firm of NEMA who is regularly engaged in manufacturing components that comply with the requirements of these specifications and that have been used on at least five projects of similar size and scope as this project.
2. Field-Testing Organization Qualifications. To qualify for acceptance, an independent testing organization must demonstrate, based on evaluation of organization submitted criteria conforming to American Society for Testing and Materials (ASTM) E 699 that it has the experience and capability to conduct satisfactorily the testing indicated.

C. **Source Quality Control**

1. Factory Tests. Design and routine tests conform to referenced standards.
2. Factory Sound Level Tests. Conduct sound-level tests on equipment for this project where specified sound levels are below standard ratings.

1.4 SUBMITTALS

A. **General.** Submit the following according to the Conditions of the Contract and Division 1 specification sections.

B. **Product data for each product** specified, including dimensioned plans, sections, and elevations. Show minimum clearances and installed features and devices.

C. **Wiring diagrams from manufacturer** differentiating between manufacturer installed and field installed wiring.

D. **Product certificates, signed by manufacturer** of transformers certifying that their products comply with the specified requirements.

E. **Product Test Reports.** Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

F. **Sound Level Test Reports.** Certified copies of manufacturer's sound level tests applicable to equipment for this project.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Temporary Heating.** Apply temporary heat according to manufacturer's recommendations within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **TRANSFORMERS, GENERAL**

A. **Transformers.** Factory assembled and tested, air cooled units of types specified, having characteristics and ratings as indicated. Units shall be designed for 60 hertz (Hz) service.

1. Cores. Grain-oriented, nonaging silicon steel.
2. Coils. Copper, continuous winding without splices except for taps.
3. Internal Coil Connections. Brazed or pressure type.
4. TP1 rated.

2.2 **GENERAL PURPOSE DRY TYPE TRANSFORMERS**

A. **Comply with NEMA Standard ST 20**.

B. **Windings.** Two-winding type. Three-phase transformers shall use one coil per phase in primary and secondary.

1. Transformers 15 kilovolt-ampere (kVA) and larger with wye connected secondaries shall have delta connected primaries.
2. Provide all copper windings.

C. **Sound Level.** Minimum of 3 decibels (dB) less than NEMA ST 20 standard sound levels for transformer type and size indicated when factory-tested in accordance with ANSI/IEEE C57.12.91.

D. **Insulation Class.** 185 degrees Celsius (° C.) or 220° C. class for transformers 15 kVA or smaller; 220° C. class for transformers larger than 15 kVA.

E. **Insulation Temperature Rise.** 80° C. maximum rise above 40° C. ambient.

F. **Provide nonventilated enclosures** in the locations noted on the drawings.

G. **Taps.** For transformers 3 kVA and larger, full-capacity taps in high-voltage winding as follows:

1. Single Phase, 3-167 kVA.

a. 3-10 kVA. 2-5 percent below normal (BN) rated high voltage.
b. 15-167 kVA. 4-2 1/2 percent BN.

2. Three Phase, 3-500 kVA.

a. 3-9 kVA. 2-5 percent BN rated high voltage.

b. 15-500 kVA. 6-2 1/2 percent; 2 above normal (AN) rated high voltage, 4 B

3. Three Phase, 750-1,000 kVA.

a. 750 kVA. 4 to 3.1 percent; 2 AN, 2 BN.
b. 1,000 kVA. 2 to 5 percent; 1 AN, 1 BN.

H. **Accessories**

1. Wall-Mounting Brackets. Provide wall-mounting brackets ONLY in the locations noted on the drawings.
2. Ceiling-Mounting Trapeze Brackets. Provide ceiling-mounting trapeze brackets ONLY where noted on the drawings. Brackets shall be finish-painted steel angle or channel brackets supplied by the transformer manufacturer or may be fabricated by methods and materials specified in Section 26 05 29, "Supporting Devices."
3. Surge Arresters. Provide metal oxide varistor-type surge arresters where indicated on drawings as follows:

a. One unit on primary.

Arresters shall comply with ANSI/IEEE 62.l1-1987.

4. Fungusproofing. Provide permanent fungicidal treatment for each coil and core.

5. Seismic Qualified. Transformers shall meet or exceed all seismic requirements of the Uniform Building Code, the Southern California Association of Engineers, and the known seismic requirements of all nuclear power plants now under construction. Tests and calculations shall meet the requirements of IEEE-34A for the "Seismic Qualification of Class 1E Electrical Equipment for Nuclear Generating Stations" as approved by the Nuclear Regulatory Commission.

2.3 CONTROL AND SIGNAL TRANSFORMERS

A. **Temperature rise shall be** 55° C.

B. **Continuous Duty Ratings**. Ratings for control power transformers shall be 50 voltamperes (VA) greater than required for control devices indicated on the control schematic diagrams shown on the contract documents. In the absence of control diagrams, provide minimum 100 VA control power transformers.

C. **Where ratings of signal transformers are not indicated,** provide capacity exceeding peak load by 50 percent minimum.

D. **Type.** Self-cooled, two-winding dry type.

E. **Enclosure.** NEMA type 1 for indoor applications. NEMA 3R for outdoor applications.

2.4 POWER CENTERS

A. **General.** Provide power centers with dry type transformers of the types, sizes, and ratings indicated on the plans. The power center shall include a main primary breaker, an encapsulated dry-type transformer, and a secondary panelboard with secondary main breaker and branch breakers. The power center shall have factory installed wiring between the primary main breaker and transformer, secondary main breaker and transformer, and panelboard section. Power center shall be UL listed and labeled and shall have a service equipment label.

B. **Circuit Breakers**

1. Provide molded case thermal magnetic circuit breakers as specified in Section 26 28 00, "Overcurrent Protective Devices."
2. The size and quantity of circuit breakers shall be as shown on the drawings. The primary main breakers shall have a minimum interrupting rating of 18,000 amps symmetrical. The secondary circuit breakers shall have a minimum interrupting rating of 10,000 amps symmetrical.

C. **Dry-Type Transformer.** Dry-type transformers shall have a minimum of two 5 percent full capacity primary taps below normal and shall be rated 115° C. temperature rise above 40° C. maximum ambient. The dry-type transformer shall be insulated with 185° C. Insulation and all insulation material shall be flame-retardant and shall not support combustion.

D. **Enclosure.** The enclosure shall be made of heavy-gauge steel and shall be degreased, cleaned, phosphatized, primed, and finished with ANSI 61 color weather resistant enamel. The enclosure shall be totally enclosed, nonventilated, NEMA 3R with lifting eyes. Primary, secondary main, and secondary branch circuit breakers shall be enclosed with a hinged door capable of being padlocked.

E. **Equipment/System Identification.** Provide equipment identification nameplates complying with Section 26 05 53, "Electrical Identification."

2.5 FINISHES

A. **Indoor Units.** Manufacturer's standard paint over corrosion resistant pretreatment and primer.

B. **Outdoor Units.** Comply with "Enclosure Coating System" article of IEEE Standard C57.12.28, "Pad-Mounted Equipment Enclosure Integrity."

2.6 MANUFACTURERS

A. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Transformers.

a. Eaton, Cutler Hammer
b. General Electric Co.
c. Siemens Energy & Automation, Inc.

2. Power Centers.

a. Eaton, Cutler Hammer
b. General Electric Co.
c. Siemens

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Arrange equipment to provide** adequate spacing for cooling-air circulation.

B. **Do not locate transformers** under panelboards.

C. **Identify transformers in accordance** with Section 26 05 53, "Electrical Identification."

D. **Tighten electrical connectors and terminals** in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL Standards 486A and 486B.

E. **Provide housekeeping pads** for all floor mounted transformers. Locate transformers at least 6 inches from walls.

F. **Make line and load connections** to transformers using liquidtight flexible conduit to reduce noise transmission through the conduit system.

G. **Orient the major horizontal axis** of a transformer at a 30 degree angle to any wall which has an office or similar quiet area on its opposite site.

H. **Mount power centers such that doors**, when open, are above 6'-6", but the operating handle of any circuit breaker is at or below 6'-6". Provide U-channel support from the floor for all power centers to be installed on drywall partitions or on 6-inch unreinforced concrete masonry unit (CMU) partitions, and for all power centers weighing over 215 pounds to be installed on unreinforced 8-inch CMU walls.

I. **Do not wall-mount transformers**:

1. Heavier than 300 pounds.
2. On drywall or 4- or 6-inch CMU partitions.
3. On a wall which has an office or similar quiet area on its opposite side.

3.2 GROUNDING

A. **Ground transformers and systems** derived from transformers as shown on the contract documents and/or as required by the NEC. Tighten connections to comply with tightening torques specified in UL Standard 486A.

3.3 FIELD QUALITY CONTROL

A. **Test Objectives.** To ensure that transformer installation is operational within industry and manufacturer's tolerances, installed according to contract documents, and suitable for energizing.

B. **Test Labeling.** Upon satisfactory completion of tests for each unit, attach a dated and signed "Satisfactory Test" label to the tested component.

C. **Schedule tests and provide** notification at least 1 week in advance of test commencement.

D. **Report.** Submit a written report of observations and tests. Report defective materials and workmanship.

E. **Tests.** Include the following minimum inspections and tests according to the manufacturer's instructions. Conform to IEEE Standard Test Code C57.12.91 for dry type units, test method, and data correction factors.

1. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.

    a. Include internal inspection through access panels and covers.
    b. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL standards 486A and 486B.

2. Insulation Resistance. Perform megohmmeter test of primary and secondary winding-to-winding and winding-to-ground. Use a minimum test voltage of 1000 volts direct current (Vdc). Minimum insulation resistance is 500 megohms.

3. Duration of Each Test. 10 minutes.
4. Temperature Correction. Correct results for test temperature deviation from 20° C. standard.

F. **Test Failures.** Correct deficiencies identified by tests and retest. Verify that equipment meets the specified requirements.

3.4 ADJUSTING AND CLEANING

A. **Upon completion of installation**, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish.

B. **Adjust transformer taps** to provide optimum voltage conditions at utilization equipment.

3.5 DEMONSTRATION

A. **Adjustment.** Arrange and pay for the services of factory authorized service representatives to adjust and demonstrate voltage regulator for Owner's maintenance personnel. Provide a minimum of 4 hours of training that include the following:

1. Safety precautions.
2. Features and construction of project equipment.
3. Voltage adjustment procedures.
4. Routine inspection and test procedures.

5. Routine cleaning.
6. Interpretation of readings of indicating and alarm devices.

B. **Schedule training** with a minimum of 7 days' notice to the Owner's Representative.

END OF SECTION

SECTION 26 24 01

SERVICE ENTRANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Division 26 Basic Electrical Materials and Methods** sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to provide service entrance work in accordance with the plans and as specified herein.

1. Extent of service entrance work is indicated by drawings and schedules.

2. Types of service entrance equipment in this section include the following:

   a. Switchboard
   b. Meter sockets.
   c. CT cabinet.
   d. Service conductors.

3. Refer to other Division 26 sections for wires/cables, raceways, and electrical boxes and fittings work required in connection with service entrance equipment.

4. Switchboards used for service entrance equipment are specified in another Division 26 Section.

5. Contractor shall pay all applicable fees to obtain electrical service from the utility company.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install service entrance equipment in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Electrical Code Compliance. Comply with applicable local code requirements of the authority having jurisdiction and National Electrical Code (NEC), including Articles 230, 250, and 338, as applicable to installation, and construction of service entrances.

2. National Electrical Manufacturers Association (NEMA) Compliance. Comply with applicable construction and installation requirements of the following NEMA standards for service entrance equipment and accessories.

3. Underwriters' Laboratories, Inc. (UL) Compliance. Comply with construction and installation requirements of the following UL standards for service entrance equipment and accessories:

UL 50	Electrical Cabinets and Boxes.
UL 854	Service Entrance Cables.
UL 869	Electrical Service Equipment.

a. Provide service entrance equipment and accessories which are UL listed and labeled, and marked, "SUITABLE FOR USE AS SERVICE EQUIPMENT."

4. Institute of Electrical and Electronic Engineers (IEEE) Compliance. Comply with applicable requirements of IEEE Standard 241 pertaining to service entrances.

5. American National Standards Institute (ANSI) Compliance. Comply with ANSI C2, "National Electrical Safety Code", installation requirements for aboveground service entrance conductors.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of service entrance equipment, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
2. Installer's Qualifications. Firm with at least 5 years of successful installation experience with projects utilizing service entrance work similar to that required for this project.

1.4 SUBMITTALS

A. **General**. Furnish manufacturer's product data, test reports, and materials certification as required.

B. **Submittals**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections:

1. Product Data. Submit manufacturer's data on service entrance equipment and accessories.

2. Shop Drawings. Submit dimensioned layouts of service entrance equipment, including spatial relationships to proximate electrical equipment.

3. Wiring Diagrams. Submit power, signal and control wiring diagrams for service entrance work. Differentiate between portion soft wiring/cabling that are manufacturer installed and portions that are field installed.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** service entrance equipment components properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory fabricated type containers or wrappings for service entrance equipment and components, which protect equipment from damage. Install gravity measuring meters in containers, which indicate whether container has been bumped or dropped. Return G-meters to manufacturer for reuse upon delivery of switchgear. Inspect equipment to ensure that no damage has occurred during shipment.

B. **Store** service entrance equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. **Handle** service entrance equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which would damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.7 SPECIAL WARRANTY

Not used.

1.8 SEQUENCING AND SCHEDULING

A. **Schedule** delivery of service entrance equipment, which permits ready building ingress for large equipment components to their designated installation spaces. Coordinate delivery of equipment with the installation of other building components.

B. **Coordinate with other electrical work** including raceways, electrical boxes and fittings, and cabling/wiring work, as necessary to interface installation of service entrance work with other work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **General.** Provide service entrance equipment and accessories; of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified.

B. **Meter Sockets and CT Cabinet**. Provide meter sockets which comply with requirements of local utility company supplying electrical power to service entrance equipment of building project.

1. Available Manufacturers. Subject to compliance with requirements, manufacturers offering meter sockets which may be incorporated in the work include, but are not limited to, the following:

    a. Circle AW Products Co.
    b. Duncan Electric Co Inc.
    c. Federal Pacific Electric Co.
    d. General Electric Co.
    e. GTE Sylvania Inc.
    f. Square D Co.
    g. Or approved equal

C. **Cables/Wires**

1. General. Provide cables/wires complying with Division 16 Basic Electrical Materials and Methods section "Wires and Cables," in accordance with the following listing unless otherwise noted:

    a. Type USE, copper cable for underground installation.
    b. Type 5E, copper cable for aboveground installation.

D. **Raceways**

1. General. Provide raceways, including conduit weatherhead if required, complying with Division 16, Section "Raceways," in accordance with the following listing:

    a. Rigid steel conduit and fittings.
    b. Intermediate steel conduit and fittings.

E. **Service Entrance Accessories**

1. Provide lightning arrester for service entrance. Unit shall be 3 phase and 600 V category. Unit shall meet ANSI/IEEE C62.11 and have a UL label. Refer to electrical drawings for exact requirements.

F. **MAINTENANCE**

1. Maintenance Stock, Fuses (where applicable). For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than five units of each.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Examine** areas and conditions under which service entrance equipment and components are to be installed, and notify Owner's Representative in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to Owner's Representative.

B. **Install service entrance equipment** as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that service entrance equipment fulfills requirements. Comply with applicable installation requirements of NEC and NEMA standards.

C. **Tighten electrical connectors and terminals**, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B, and the NEC.

3.2 FIELD QUALITY CONTROL

A. **Check accessible connections** for compliance to manufacturer's torque tightening specifications prior to energization of service entrance equipment.

B. **Check insulation resistance levels** with ground resistance tester, phase-to-phase and phase-to-ground, to ensure requirements are fulfilled prior to energization of service entrance equipment.

C. **Check circuitry** for electrical continuity, and for short circuits prior to energization.

3.3 ADJUSTING

A. **Adjust** operating mechanisms for free mechanical movement.

3.4 DEMONSTRATION

A. **General**. Upon completion of installation of service entrance equipment and electrical circuitry, energized circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

3.5 ALLOWANCE

A. Contractor shall include an allowance as specified in the Bid Form in his/her bid to cover the utility charges associated with the Electric Power Company work. All other work beyond the Electric Power Company's service pole including riser pole assemblies and pole mounted hardware, trenching, backfilling, primary & secondary service conduits and conductors, pad mounted transformers, transformer pads, grounding, metering, manholes, temporary electrical service work, etc. shall be carried under the Contractor's base bid as shown on the drawings and specified herein. If the utilities charge, when determined, is more or less than the stated allowance, the contract sum shall be adjusted accordingly by change order. The balance of the work to complete the entire electric service for the project will be the responsibility of the Contractor.

END OF SECTION

SECTION 26 24 13

LOW VOLTAGE SWITCHBOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 53, "Electrical Identification."
4. Section 26 09 13, "Power System Metering and Control."
5. Section 26 28 00, "Overcurrent Protective Devices."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install switchboards in accordance with the plans and as specified herein.

B. **This section includes low-voltage** power service and distribution switchboards and associated auxiliary equipment rated 600 volts (V) or less.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Provide switchboards in compliance with the requirements of governing agencies having jurisdiction and in accordance with the plans and as specified herein.

1. Listing and Labeling. Provide switchboard assemblies that are listed and labeled.

   a. The terms "listed" and "labeled," as defined in the National Electrical Code (NEC), Article 100.

2. National Fire Protection Association (NFPA) 70, National Electrical Code (NEC).
3. National Electrical Manufacturers Association (NEMA) Standard PB2, "Deadfront Distribution Switchboards."
4. Underwriters' Laboratories, Inc. (UL) Standard 891, "Deadfront Switchboards."

B. **Product Selection for Restricted Space**. The drawings indicate maximum dimensions for switchboard equipment including clearances between switchboard and adjacent surfaces and items. Switchboards having equal

performance characteristics and complying with indicated maximum dimensions may be considered.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for each product and component specified.
2. Shop drawings for each switchboard including dimensioned plans and elevations, component and device lists, and a single line diagram showing main and branch bus current ratings and short time and short circuit ratings of switchboard.
3. Shop drawings of utility company metering provisions with indication of approval by utility company.
4. Schedule of features, characteristics, ratings, and factory settings of individual protective devices.
5. Manufacturer's schematic wiring diagram in ladder diagram form. Label each rung and each device in plain English. Label shall describe intended function.
6. Point to Point Control Wiring Diagram. Differentiating between manufacturer installed and field installed wiring (may be submitted upon delivery of switchboard).
7. Qualification data for field testing organization certificates, signed by the Contractor, certifying that the organization complies with the requirements specified in Quality Assurance above. Include list of completed projects with project names, addresses, names of Engineer and Owners, plus other information specified.
8. Report of field tests and observations certified by the testing organization.
9. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 26 section "Basic Electrical Requirements."
10. Coordination and selectivity report as described in Section 26 00 01.

1.5 JOB CONDITIONS

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Deliver in shipping splits** of lengths that can be moved past obstructions in delivery path as necessary.

B. **Store so condensation will not occur** on or in switchboards. Provide temporary heaters if storage building is not adequately heated to ensure avoiding condensation.

C. **Handle switchboards in accordance** with NEMA Standard PB2.1, "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards." Use factory installed lifting provisions.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **General**

1. Description. Front accessible sections, front- and rear-aligned, with features as follows:
   a. Main Devices. Individually compartmented, fix mounted type. 100% rated with solid-state trip, LSIG.
   b. Branch Devices. Group, fixed mounted. 80% rated, LSIG.

2. Barriers. Between adjacent switchboard sections.

   a. Insulation and isolation for main and vertical buses of feeder sections.
   b. Insulation and isolation for main bus of main section and main and vertical bus of feeder sections.

B. **Enclosure and Accessories**

1. Enclosure Finish for Indoor Units. Manufacturer standard gray finish over a rust-inhibiting primer on phosphatizing treated metal surface. Provide painted surfaces that conform to IEEE C37.20.1, "Standard for Metal Enclosed Low-Voltage Power Circuit Breaker Switchgear," paragraph 5.2.8. NEMA type 1. **The switchboard's physical dimensions cannot exceed those shown on contract drawings.**

2. Switchboard shall be designed for the following conditions:

   a. Service entrance rated.

3. Utility Metering Compartment. Fabricated compartment and section meeting utility company requirements. Where separate vertical section is required for utility metering, match and align with basic switchboard.

4. Bus Transition and Incoming Line Pull Sections. Match and align with basic switchboard.

5. Hinged Front Panels. Provide to allow access to breaker, metering, accessory, and blank compartments.

6. Buses and Connections. Three phase, four wire except as otherwise indicated. Features as follows:

    a. Phase and Neutral Bus Material. Hard drawn copper of 98 percent conductivity with feeder circuit breaker line connections.
    b. Where bus is copper, use copper for feeder circuit breaker line connections.
    c. Ground Bus. 1/4 inch by 2 inch minimum size, hard drawn copper of 98 percent conductivity, and equipped with pressure connector terminations for feeder and branch circuit ground conductors. For busway feeders extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
    d. Supports and Bracing for Buses. Adequate strength for indicated short circuit currents.
    e. Contact Surfaces of Buses. Silver plated.
    f. Main Phase Buses, Neutral Bus, and Equipment Ground Bus. Uniform capacity the entire length of the switchboard main and distribution sections.
    g. Neutral Buses. 100 percent of the ampacity of the phase buses except as indicated and equipped with approved pressure connector terminations for outgoing circuit neutral cables. Provide braced neutral bus extensions for busway feeders with neutral conductors.

C. Mains, Tie & Feeder Circuit Breakers

1. Provide indicated features, ratings, characteristics, and settings for circuit breakers as shown on the drawings. All main service disconnects shall be provided with service entrance label. Provide ground fault interrupt function for all main service disconnects 1,000 amps, 3 phase, 4 wire or larger. The interrupting rating shall meet or exceed bracing requirements.

2. The switchboard’s mains (normal power mains), tie breaker and feeder breakers shall be a solid-state trip, insulated case, power circuit breaker 100 percent rated for the mains and tie breakers and 80 percent rated for feeder breakers, electronic trip. Solis-state trip devices shall include ground-fault, long time, short time, and instantaneous, short time pickup and zone selective interlocking (all field adjustable) features to provide for proper selectivity up to 0.1 seconds.

3. The switchboard's mains, tie and feeder breakers shall be provided with Arc Flash reduction maintenance mode switch to limit total clearing time to 0.04 seconds (2.5 cycles).

4. The trip and sensing devices shall be microprocessor-based, true RMS sensing design.

D. Mains And Tie Circuit Breakers (two normal power mains and one tie breaker)

1. Insulated case circuit breakers shall be individually mounted.

2. Mains and tie breakers shall be electrically operated.

3. Breakers shall be constructed of a high dielectric strength, glass reinforced insulating case. The interrupting mechanism shall be arc chutes. Steel vent grids shall be used to suppress arcs and cool vented gases. Interphase barriers shall to isolate completely each pole.

4. Breakers shall contain a true two-step stored energy operating mechanism which shall provide quick make, quick break operation with a maximum five cycle closing time. Breakers shall be trip free at all times. Common tripping of all poles shall be standard.

5. Breakers shall be rated to carry 100 percent of their frame ampacity continuously.

6. A charging handle, close push-button, open push-button, and Off/On/Charge indicator shall be located on the breaker escutcheon and shall be visible with the breaker compartment door closed.

7. The two main and the tie breakers shall be kirk key interlocked.

E. Digital Electronic Trip Unit Features

1. Each main and feeder circuit breaker shall be equipped with a digital electronic trip unit. The trip unit shall provide protection from overloads, short circuits and ground faults. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.

2. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.

3. Long time and short time protective functions shall have true RMS sensing technology for harmonic rich currents including up to the 19th harmonic.

4. Noise immunity shall meet the requirements of IEEE C37.90.

5. The trip unit shall display trip targets for long time, short time, and ground fault, if included.

6. Provide visual illuminated indication of the trip unit (normal, pickup, trip, error).

7. The trip unit shall be provided with a ten event trip history log. Each trip event shall be recorded with type, phase and magnitude of fault that caused the trip.

8. As a minimum, the trip unit shall have the following protective functions:
   a. Current setting or long time pickup, adjustable from 50% to 100%.
   b. Adjustable long time delay with typical inverse time characteristics (minimum of 10 bands). In addition, a set of straight line fuse shaped long time delay bands shall be provided to facilitate selectivity with downstream fuses (minimum 7 bands).
   c. Instantaneous pickup, adjustable from 2.0 to 10 times the rating plug in 0.5 increments
   d. Short time pickup and delay. Short time pickup shall be adjustable from 1.5 to 9 times the long time pickup setting in 0.5 increments with an OFF option. Provide minimum of 12 short time delay bands with three selectable I^2t bands.
   e. Adjustable ground fault pickup and delay. Ground fault pickup shall be adjustable from 0.4 to 1.0 times the breaker sensor rating in 0.05 increments. Provide a minimum of 15 ground fault delay bands with three selectable I^2t bands.
   f. Reduced Energy Let-Through (RELT) Instantaneous trip. When specified this feature shall be provided on all main and feeder breakers to provide a temporary setting for the instantaneous trip setting of the breaker. Setting shall be adjustable down to 1.5X of the rating plug and shall be enabled through a switch mounted on front of the switchboard. The switch shall be combined with an indicating light that positively indicates that the RELT is enabled or disabled.

9. The trip unit shall display rms current, each phase, on the LCD.

10. The following monitored values shall also be displayed on the trip unit LCD:
   a. Voltage, rms, line - to - line, or line - to - neutral;
   b. Energy, KWH, total;
   c. Demand KWH, over an adjustable time period of 5 to 60 minutes;
   d. Peak demand, KW, user resettable;
   e. Real power, KW, line - to - line, line - to - neutral;
   f. Total (apparent) power, KVA, line - to - line, line - to - neutral.
   g. Reactive Power, KVAR, line - to - line, line - to - neutral.
   h. Power Factor (%)
   i. Frequency (Hz)

11. Trip shall be provided with serial communications using Modbus RTU protocol. Manufacturer's literature shall provide full register map.

12. Trip unit shall provide waveform capture capability for fault events. Capture data shall include 4 cycles before and 4 cycles after the event or can be initiated through a Modbus command.

13. If a manufacturer's trip unit cannot incorporate the above specified metering functions, separate device(s) with equal function shall be provided for each breaker.

F. Instrument Transformers. NEMA Standard EI 21.1, "Instrument Transformers for Revenue Metering 110 [Kilovolt] kV BIL and Less," IEEE Standard C57.13, "Requirements for Instrument Transformers," and the following:

a. Potential Transformers. Secondary voltage rating of 120 volts and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
b. Current Transformers. Ratios as indicated and accuracy class suitable for connected relays, meters, and instruments.

1. Multifunction Digital Metering Monitor. (See Section 16430) UL listed or recognized microprocessor based unit suitable for three or four wire systems and with the following features:

c. Inputs. From sensors or current transformers from 100/5 through 5000/5 ratings and potential terminals up to 600 volts.

d. Display. Switch selectable digital display of the following values with maximum accuracy tolerances as indicated:

1) Phase currents, each phase, ±1 percent.
2) Phase to phase voltages, 3 phase, ±1 percent.
3) Phase to neutral voltages, 3 phase, ±1 percent.
4) Megawatts, ±2 percent.
5) Megavars, ±2 percent.
6) Power factor, ±2 percent.
7) Frequency, ±0.5 percent.
8) Megawatt demand with demand interval programmable from 5 to 60 minutes, ±2 percent.
9) Isolated 4-2 OMADC output proportional to the kW usage.
10) % THD, current and voltage.

e. Mounting. Display and control unit flush or semiflush mounted in instrument compartment door.

G. **Ratings**

1. Voltage and current rating of switchboards shall be as shown on the drawings. Unless otherwise shown, the interrupting rating of switchboards shall be 42,000 amperes symmetrical.

H. **Accessory Components and Features**

1. Accessory Set. Include tools and miscellaneous items as required for OCPD test, inspection, maintenance, and operation. Provide special tools for lug tightening and compartment access (pentahead).
2. Portable Test Set. Arranged to permit testing of all functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
3. Fungus Proofing. Permanent fungicidal treatment for switchboard interior including instruments and instrument transformers.

I. **EXTRA MATERIALS**

1. Spare Fuses. Six spares of each type and rating of fuse and fusible devices used. Include spares for:

   a. Potential transformer fuses.
   b. Control power fuses.

2. Spare Indicating Lights. Six of each type installed.

3. Touch-Up Paint. Three half-pint containers.

4. One spare 2000A, electric operated, fixed mounted style breaker complete with electronic trip units capable of replacing any of the five main breakers within the system.

5. One lifting device for installation/removal of breaker to/from its compartment.

6. Rubber Mats: A three foot wide rubber mat shall be furnished and installed on the floor and in front of the new switchboard assembly and the MCCs. The mats shall be long enough to cover the full length of the equipment line-up. The mats shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mats shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mats shall meet OSHA requirements and the requirements of ANSI/ASTM D 178 J6-7 for Type 2, Class 2 insulating matting.

J. **Identification**

1. General. Refer to Division 26 section "Electrical Identification." Identify units, devices, controls, and wiring with factory applied labels and signs.
2. Compartment Nameplates. Engraved laminated plastic or metal nameplate for each compartment, mounted with corrosion resistant screws. Each compartment shall bear a nameplate or nameplates to identify component (switch, breaker, starter, metering, or arrestor) and its identifier (Infl. Station Feeder, Aeration Blower No. 1, KWH Meter, etc.)

2.2 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Eaton, Cutler Hammer.
2. General Electric Co.
3. Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Install switchboards and accessory items** in accordance with manufacturers' written installation instructions and the following specifications.

B. **Anchor each switchboard assembly** to two 4-inch-minimum channel iron sills arranged in accordance with manufacturer's recommendations. Attach by tack welding or bolting. Level and grout sills flush with switchboard mounting surface

C. **Housekeeping Pads**

1. Provide and install housekeeping pads for all switchboards.

D. **Temporary Lifting Provisions**. Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

E. **Operating Instructions**. Frame and mount printed, basic operating instructions for switchboards, including control and key interlocking sequences, and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on the front of the switchboards. Provide wiring diagram for each section.

3.2 IDENTIFICATION

A. **Identify field-installed wiring** and components and provide warning signs as specified in Division 26 section "Electrical Identification."

3.3 GROUNDING

A. **Ground equipment to main electrical** ground bus indicated. Provide maximum 5-ohm ground resistance at switchboard location.

3.4 CONNECTIONS

A. **Tighten switchboard bus joint bolts** and electrical connector and terminal bolts in accordance with manufacturer's published torque tightening values. Where manufacturer's torque values are not stated, use those specified in UL Standards 486A and 486B. Provide permanent interior labels listing torque requirements.

3.5 FIELD QUALITY CONTROL

A. **Comply with applicable standards** of the InterNational Electrical Testing Association (NETA) including Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."

B. **Arrange and pay for the services** of a factory-authorized service representative to supervise the pretesting and adjustment of switchboard components for a total of three working days.

C. **Pretesting**. Upon completing installation of the system, perform the following preparations for tests:

1. Make insulation resistance tests of switchboard buses, components, and connecting supply, feeder, and control circuits.
2. Make continuity tests of circuits.
3. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
4. Provide manufacturer's instructions for installation and testing of switchboard to test organization.

D. **Quality Control Testing Program**. Conform to the following:

1. Program Objectives. To ensure that switchboard installation meets specified requirements, is operational within specified tolerances, provides appropriate protection for systems and equipment, and is suitable for energizing.
2. Procedures. Make field tests and inspections and prepare switchboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
3. Schedule tests and notify Engineer/Architect at least 1 week in advance of test commencement.
4. Reports. Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of adjustments and remedial efforts.
5. Labeling. Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, person responsible, and date.
6. Protective Device Ratings and Settings. Verify indicated ratings and settings and make the final system adjustments of OCPDs in accordance with Division 26 section "Overcurrent Protection Devices." In addition verify the coordination and selectivity settings between the main disconnect device and distribution section circuit breakers in accordance with Section 26 00 01.

E. **Visual and Mechanical Inspections**. Include the following inspections and related work:

1. Inspect for defects and physical damage, testing laboratory, labels, and nameplate compliance with up-to-date circuit connections.
2. Verify that potential transformers, including their overcurrent protection and current transformers, meet specified requirements.

3. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
4. Check switchboard anchorage, area clearances, and alignment and fit of components.
5. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
6. Clean switchboard interior and exterior using manufacturer's approved methods and materials.
7. Perform visual and mechanical inspection and related work for OCPDs as specified in section "Overcurrent Protective Devices."

F. **Electrical Tests**. Include the following items performed in accordance with manufacturer's instruction:

1. Insulation resistance test of buses and portions of control wiring that disconnect from solid state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable.
2. Ratio and polarity tests on current and voltage transformers according to ANSI standards.
3. Ground resistance test on system and equipment ground connections according to ANSI standards.
4. Calibrate ammeters and voltmeters at midscale. Use check instruments with documented up to date calibration traceable to National Institute of Standards and Technology (NIST) standards.
5. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformer and control power wiring.
6. Calibrate watt-hour and demand meters to 0.5 percent, and verify meter multipliers. Use check instruments with documented up-to-date calibration traceable to NIST standards.
7. Check phasing of alternate supply sources to the same bus.
8. Test OCPDs as specified in section "Overcurrent Protective Devices."

G. **Retesting**. Correct deficiencies identified by tests and observations and retest switchboards. Verify by the retests that switchboards meet specified requirements.

3.6 CLEANING

A. **Upon completion of installation**, inspect interior and exterior of switchboards. Prior to substantial completion remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.7 PROTECTION

A. **Apply temporary heat** in accordance with manufacturer's recommendation within each section of switchboard throughout periods during which the switchboard is not in a space that is continuously under normal control of temperature and humidity.

3.8 **FIELD TRAINING**

A. **Provide the services of** vendor's field engineer to conduct operator training as required.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following Division 26 sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 53, "Electrical Identification."
4. Section 26 28 00, "Overcurrent Protective Devices,"

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install panelboards and enclosures in accordance with the plans and as specified herein.

B. **Miscellaneous.** This section includes lighting and power panelboards and associated auxiliary equipment rated 600 volts or less.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with panelboards in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Listing and Labeling**. Provide products specified in this section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code (NEC), Article 100.
2. Listing and Labeling Agency Qualifications. A "Nationally Recognized Testing Laboratory" (NRTL) as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.

C. **Electrical Component Standard**. Components and installation shall comply with National Fire Protection Association (NFPA) 70, NEC.

D. **National Electrical Manufacturers Association (NEMA) Standard**. Comply with NEMA PB1, "Panelboards."

E. **Underwriters' Laboratories, Inc. (UL) Standards**. Comply with UL 67, "Panelboards," and UL 50, "Cabinets and Boxes."

1.4 SUBMITTALS

A. **Furnish manufacturer's product data**, test reports, and materials certifications as required.

B. **General**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Product data for each type panelboard, accessory item, and component specified.

2. Shop drawings from manufacturers of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

   a. Enclosure type with details for types other than NEMA Type 1.
   b. Bus configuration and current ratings.
   c. Short circuit current rating of panelboard.
   d. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
   e. Spare Fuse Cabinets. Show materials, dimensions, and features including storage provisions for fuse cartons.

3. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring. Provide ladder diagrams for each motor controller.

4. Report of field tests and observations certified by the testing organization.

5. Panel schedules for installation in panelboards. Submit final versions after load balancing.

6. Maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 26 section "Basic Electrical Requirements." Include instructions for testing circuit breakers.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver panelboards and components** properly packaged in factory-fabricated-type containers.

B. **Store panelboards and components** in original packaging and in a clean, dry space; protect from weather and construction traffic.

C. **Handle panelboards and components** carefully to avoid breakages, impacts, denting, and scoring finishes. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.

1.7 **SPECIAL WARRANTY**

Not used.

1.8 **DEFINITIONS**

A. **Overcurrent Protective Device (OCPD).** A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **General**

1. Panelboards shall be fully rated provided with bolt-on main and branch breakers.

2. OCPD. Provide type, rating, and features as indicated. Comply with Section 26 28 00, "Overcurrent Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

3. Enclosures. Cabinets, flush or surface mounted as indicated. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated.

   a. NEMA 3R. Raintight.
   b. NEMA 3S. Raintight and dusttight.
   c. NEMA 4X. Corrosion resistant fiberglass enclosure, watertight, dusttight, and resistant to oil and coolant seepage.
   d. NEMA 12. Dusttight, dripproof, and resistant to oil and coolant seepage.

4. Front. Secured to box with concealed trim clamps except as indicated. Front for surface mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified.

5. Directory Frame. Metal, mounted inside each panel door.

6. Phase and Full Sized Neutral Bus. Hard-drawn copper of 98 percent conductivity. Bus bracing shall meet or exceed OCPD interrupt rating unless otherwise noted.

7. Main and Neutral Lugs. Compression type.

8. Equipment Ground Bus. Copper adequate for feeder and branch circuit equipment ground conductors. Bonded to box.

9. Provision for Future Devices. Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

10. Special Features. Provide the following features for panelboards as indicated.

    a. Extra Gutter Space. Dimensions and arrangement as indicated.
    b. Gutter Barrier. Arranged to isolate section of gutter as indicated.
    c. Auxiliary Gutter. Conform to UL 870, "Wireways, Auxiliary Gutters, and Associated Fittings."
    d. Column Type Panelboard Configuration. Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses.
    e. Subfeed. OCPD or lug provision as indicated.
    f. Feed Through Lugs. Sized to accommodate feeders indicated.
    g. Surge Arresters. Institute of Electrical and Electronics Engineers (IEEE) C62.11 "Standards for Metal Oxide Surge Arresters for AC Power Circuits," or IEEE C62.1 "Surge Arresters for Alternating Current Power Circuits."

B. **Lighting and Appliance Branch Circuit Panelboards**

1. Branch OCPDs. Bolt on circuit breakers, replaceable without disturbing adjacent units.
2. Double Width Panels. Where more than 42 poles are indicated, provide two panelboards under single front.
3. Doors. In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.
4. Ratings. Voltage and current rating of panelboards shall be as shown on the drawings. Unless otherwise shown, the interrupting capacity shall be 22,000 amperes symmetrical for 480Y/277 volt, 3 phase, 4 wire panelboards, and 10,000 amperes symmetrical for 208Y/120 volt, 3 phase, 4 wire and 120/240 volt, single phase, 3 wire panelboards.

C. **Distribution Panelboards**

1. Doors. In panel front, omit single panelboard door in cabinet front for fusible switch panelboards except as indicated. Secure with vault type with tumbler lock, all keyed alike.

2. Branch Circuit Breakers. Where OCPDs are indicated to be circuit breakers, use bolt on breakers except circuit breakers 225 ampere frame size and greater may be plug in type where individual positive locking device requires mechanical release for removal.

3. Motor Starter Branches. Conform to Division 26 section "Motor Controllers" and provide units equipped for panelboard mounting. Include the following accessories and pilot devices as indicated:

    a. Individual control power transformers.
    b. Fuses for control power transformers.
    c. Pilot lights.
    d. Extra interlock contacts.
    e. Push buttons.
    f. Selector switches.

4. Motor Starter Disconnects. Include overcurrent protection as indicated. Mount integral with or, in same panelboard, adjacent to motor starter. Mechanically interlock starter door with disconnect device. Provide auxiliary contacts on disconnect to de-energize control connections to starter.

5. Ratings. Voltage and current rating of panelboards shall be as shown on the drawings. Unless otherwise shown, the interrupting capacity shall be 22,000 amperes symmetrical.

D. **Accessory Components and Features**

1. Accessory Set. Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.
2. Portable Test Set. Arranged to permit testing of functions of solid state trip devices without removal from panelboard.
3. Spare Fuse Cabinet. Identified, compartmented, lockable steel box or cabinet with compartments suitable for surface mounting on wall.
4. Fungusproofing. Permanent fungicidal treatment for panelboards interior including OCPDs and other components.

E. **Extra Materials**

1. Keys. Furnish six spares of each type for panelboard cabinet locks.
2. Touch-up Paint for Surface Mounted Panelboards. One 1/2-pint container.

F. **Identification**

1. General. Refer to Division 26 section "Electrical Identification" for labeling materials.
2. Panelboard Nameplates. Engraved laminated plastic or metal nameplate as specified in Section 26 05 53, "Electrical Identification," for each panelboard mounted with 316 stainless steel screws.

2.2 **MANUFACTURERS**

A. **Available Manufacturers.** Subject to compliance with requirements, provide products by the following:

1. Eaton, Cutler-Hammer
2. General Electric Co.
3. Square D. Co.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **General.** Install panelboards and accessory items in accordance with NEMA PB 1.1,"General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.

B. **Ground Fault Protection**. Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."

C. **Mounting Heights**. Top of trim 6'-2" above finished floor, except as indicated.

D. **Mounting**. Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.

E. **Install filler plates** in unused spaces.

F. **Provision for Future Circuits at Flush Panelboards**. Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future. Stub four 1-inch empty conduits into raised floor space or below slab other than slabs on grade.

G. **Wiring in Panel Gutters**. Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.2 IDENTIFICATION

A. **Identify field-installed wiring** and components and provide warning signs in accordance with Section 26 05 53, "Electrical Identification." Label each OCPD with circuit number(s) to match schedule. Provide permanent label to each circuit conductor (Hot, Neutral, Ground) identifying the panel and circuit number (e.g., LPA-12).

B. **Circuit Directory**. Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing. Number branch circuit devices accordingly to correspond to circuit directory.

3.3 GROUNDING

A. **Provide ground connection** between panel enclosure and feeder ground conductor.

3.4 CONNECTIONS

A. **Tighten electrical connectors and terminals**, including grounding connections, in accordance with manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. **Pretesting**. Upon completing installation of the system, perform the following preparations for independent tests:

1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.
2. Make continuity tests of circuits.
3. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

B. **Quality Control Program**. Conform to the following:

1. Procedures. Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
2. Schedule tests with notification at least 1 week in advance.
3. Labeling. Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.
4. Protective Device Ratings and Settings. Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.

C. **Visual and Mechanical Inspection**. Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Perform visual and mechanical inspection and related work for overcurrent protective devices as specified in Division 26 section "Overcurrent Protective Devices."

D. **Electrical Tests**. Include the following items performed in accordance with manufacturer's instructions:

1. Insulation resistance test of buses and portions of control wiring that disconnected from solid state devices. Insulation resistance less than 100 megohms is not acceptable.
2. Ground resistance test on system and equipment ground connections.
3. Test main and subfeed overcurrent protective devices in accordance with section "Overcurrent Protective Devices."
4. Retest. Correct deficiencies identified by tests and observations and provide retesting of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

E. **Cleaning**

1. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

F. **Commissioning**

1. Balancing Loads. After substantial completion, but not more than 2 months after final acceptance, conduct load balancing measurements and circuit changes as follows:

    a. Perform measurements during period of normal working load as advised by the Owner.
    b. Perform load balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24 hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
    c. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
    d. Tolerance. Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

END OF SECTION

SECTION 26 24 19

LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 26, "Grounding."
4. Section 26 05 53, "Electrical Identification," for identification labels and warning signs for motor control centers (MCCs) and their components.
5. Section 26 29 00, “Motor Controllers," for motor control devices installed in MCCs.
6. Section 40 93 13, "Control Devices."

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install MCCs in accordance with the plans and as specified herein.

1. This section includes MCCs for use on alternating current (ac) circuits rated 600 volts (V) or less. Extent of MCC work is indicated by drawings and schedules.

2. Types of MCC components specified in this section include the following:

a. MCC supporting structures.
b. Bus systems.
c. Unit compartments.
d. Motor controller units.
e. Feeder units.
f. Overload protection.
g. Overcurrent protection.
h. Control components.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install MCCs in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Listing and Labeling. Provide MCCs that are listed and labeled.

   a. The Terms "Listed" and "Labeled." As defined in the National Electrical Code (NEC), Article 100.
   b. Listing and Labeling Agency Qualifications. A "Nationally Recognized Testing Laboratory" (NRTL) as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.

2. National Electrical Manufacturers Association (NEMA) Standard. NEMA ICS 2, "Standards for Industrial Control Devices, Controllers and Assemblies."

3. Underwriters' Laboratories, Inc. (UL) Standard. UL 845, "Motor Control Centers."

1.4 SUBMITTALS

A. **Product Data.** Submit manufacturer's technical product data on MCC. Application data to include, but not be limited to, the following:

1. Voltage.
2. Phase.
3. Frequency.
4. Horizontal bus capacity.
5. Vertical bus capacity.
6. Short circuit ratings.
7. Main and branch circuit breaker ratings.
8. Types of motor controllers.
9. Types of wiring (NEMA type wiring).
10. Enclosures.
11. Sections.
12. Motor size and overload heaters.
13. Panels and transformers.
14. Control components.
15. Overcurrent protective devices.
16. Metering components.

B. **Shop Drawings.** Submit layout drawings of MCCs showing accurate scaled basic equipment sections including, but not limited to, motor controllers, device panels, and circuit breakers. Show spatial relationships of MCC components to proximate electrical equipment. Submit unit wiring diagrams and elementary control wiring diagrams which show all external devices connected to the motor control circuit. Control wiring diagrams shall be in ladder logic form. Clearly differentiate on wiring diagrams those conductors which are factory installed and those which are field installed. Provide terminal and wire numbers on control diagrams.

C. **Maintenance Data.** Submit maintenance data and parts list for each MCC, including "troubleshooting" maintenance guide. Include that data, product data, and shop drawings in a maintenance manual.

1.5 **JOB CONDITIONS**

A. **Coordination.** Coordinate with other trades to prevent delays, omissions, or errors.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery.** Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. **Storage.** Store so condensation will not occur on or in MCCs. During storage, provide temporary heaters to prevent condensation from occurring.

C. **Handling.** Handle MCCs in accordance with NEMA ICS 2.3, "Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers." Use factory installed lifting provisions.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **GENERAL**

A. **Provide MCCs** and ancillary components which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information.

B. **Main Entrance.** Provide MCCs for top or bottom main entry as determined by field verification and conditions. Preferred entry is bottom entry. All MCCs installed above accessible spaces shall utilize Type 304 stainless steel underfloor pull boxes with angle iron frames. Boxes shall be dusttight. Conduit entrance shall be via a grounding, threaded fitting.

C. **Ratings.** Voltage and current rating of MCCs shall be as shown on the drawings. Unless otherwise shown, the short circuit withstand rating of MCCs shall be a minimum 42,000 amperes RMS symmetrical. Provide each MCC, with a microprocessor-based main protective device to minimize the “arc flash” current.

2.2 CONSTRUCTION

A. **General.** Provide MCCs consisting of one or more vertical sections, each with groupings of unit compartments containing motor controllers, feeder, and auxiliary devices as indicated.

B. **Wiring.** Provide MCC with NEMA Class 2, Type B wiring. All wiring shall be identified by a permanent plastic heat shrink label at each termination.

C. **Supporting Structures.** Provide factory-assembled, deadfront, vertical MCC sections, as shown on the plans, fastened together to form rigid freestanding assembly. Construct each section 90 inches high, 20 inches wide, and a minimum of 15 inches deep. Provide NEMA Type 1 enclosure for MCC's located in dedicated electrical rooms, NEMA Type 12 enclosures for MCC's located in dry interior locations. Construct each section with 6-inch-minimum horizontal wireways at top and bottom and a 4-inch-wide, 6-inch-deep, 72-inch-high vertical wireway on the right. The vertical wireway shall be accessible through hinged doors and with supports at proper intervals within for fastening wires/cables. Form supporting members of not less than 13-gauge hot rolled steel. Construct structure doors with removable pin hinges and secure with quarter turn indicating type fasteners. Provide removable lifting angle full length of MCC. Design lifting angle to support entire weight of MCC section. Design bottom channels to be removable; provide holes for bolting MCC units to floor. Provide shipping splits in MCC lineup to allow for shipment of maximum 60-inch-long units. Design MCCs so matching vertical sections of same current rating and manufacturer can be added later at either end of lineup without use of transition sections. Provide removable end and top plates to close off openings.

D. **Bus System.** Provide tin-plated copper bus bars. Provide main horizontal bus with an ampere rating as shown on the drawings. Provide vertical bus rated for 600 amperes for MCCs unless otherwise noted on the drawings. Construct vertical bus bar barriers with automatic shutters to cover bus stab openings when units are removed. Provide tin-plated copper ground bus running full width of MCC at bottom of lineup. Drill ground bus and furnish lugs for each unit compartment.

E. **Equipment/System Identification.** Provide equipment/system identification nameplates complying with Section 26 05 53, "Electrical Identification," in accordance with the drawings.

F. **Finishes.** Thoroughly clean interior and exterior of supporting structures and unit compartments prior to coating of MCC, including bolted joints, with rust inhibiting prime coat. Provide two finish coats of manufacturer's standard color baked-on enamel or electrostatically applied powder paint.

2.3 UNIT COMPARTMENTS

A. **General.** Provide draw-out-type unit compartments with doors, unit support pans, saddles, and disconnect operators. Enclose and isolate each unit from adjacent units. Provide draw-out units with a de-energized position where the unit is still supported by the structure, but no electrical connection is made. Provide a method of locking the unit in the de-energized position. Design plug-in units of the same type and size to be interchangeable with each other.

Provide plug-on connections for each electrical power phase. Design the contact fingers to be floating and self-aligning. Tin-plate the contacts for low resistance connections. Interiors shall be painted white or off-white. Units shall have pull-apart terminal strips.

B. **Unit Doors.** Provide unit doors securely mounted with a minimum of two rugged concealed type hinges which allow doors to swing open a minimum of 115 degrees for ease of unit maintenance and withdrawal. Fasten doors to structure so that they remain in place when unit is withdrawn. Closed door must cover unit space when unit has been temporarily removed. Provide interlock for each unit door with associated disconnect mechanism to prevent door from opening when unit is energized.

C. **Disconnect Operators.** Provide external operator handles for controllers, switches, and circuit breakers. Design handle with up-down motion and with down position indicating OFF. Construct handles which permit locking handle in OFF position with three padlocks.

D. **Circuit Breakers.** Provide thermal magnetic molded case circuit breakers as specified in Section 26 28 00, "Overcurrent Protective Devices." Sizes shall be as shown on the drawings.

E. **Fused Switches.** Provide fused switches, sized as indicated, incorporating quick make, quick break type mechanism. Construct so that switch blades are visible in the OFF position with the door open. Construct current-carrying parts of high conductivity copper, with silver tungsten type switch contacts. Provide positive pressure type Class R rejection type fuse clips. Provide dual element current limiting UL Class R fuses.

F. **Main Circuit Breakers.** Provide solid-state trip circuit breakers as specified in Section 26 28 00, "Overcurrent Protective Devices." See plans for size. The main service for every building shall have a service equipment label.

G. **Main Switch.** Provide it with microprocessor-based protection. See plans for size. The main service for every building shall have a service equipment label.

H. **Motor Controller Units.** Provide combination type motor controller units, types as specified in Section 26 29 00, "Motor Controllers," with thermal magnetic circuit breaker or fused switch as indicated. Provide a 120-volt control power transformer for each motor controller unit with two primary fuses and one secondary fuse. The transformer secondary shall be grounded. Units shall be NEMA rated.

2.4 ACCESSORIES

A. **Control Components.** Provide quantity and type of control components and auxiliary contacts indicated in the drawings and/or schedules. Control devices shall be as specified in Section 40 93 13, "Control Devices." All control equipment conductors shall be landed with vinyl insulated locking fork terminals.

B. **Master Terminal Block.** A master terminal block shall be provided in the horizontal wireways at the top and bottom of the MCC for connection to control interlock wiring. Each terminal block shall be sized for 20 percent spare for future use.

2.5 MANUFACTURERS

A. **Manufacturers.** Subject to compliance with requirements, provide products by the following:

1. Eaton, Cutler Hammer

B. Alternate Bid Equipment

1. Allen Bradley
2. General Electric Co.
3. Siemens

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Inspection**. Examine areas and conditions under which MCCs are to be installed, and substrate which will support MCCs. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2 INSTALLATION

A. **General.** Install MCCs as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, complying with applicable requirements of NEC, NEMA's Standard Pub/No. ICS-2, and NEC "Standard of Installation."

1. Provide and install housekeeping pads for all MCCs.
2. Coordinate with other electrical work including wiring/cabling and raceway work, as necessary to interface installation of MCCs with other work. Install control wiring from master terminal blocks in top and bottom horizontal wireways to all associated unit compartment terminal blocks.
3. Install fuses, if any, in MCC units.
4. Seal all conduit and cable tray entrances to MCCs, after wire installation, with silicone foam.
5. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening

values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.

6. Provide equipment grounding connections for MCCs as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounds.

3.3 FIELD QUALITY CONTROL

A. **Prior to energization of MCCs**, check with insulation resistance tester for proper values of phase-to-phase and phase-to-ground insulation resistances. Log that data, and submit to Engineer.

B. **Prior to energization of circuitry**, check control center electrical circuits for continuity and for short circuits.

C. **Subsequent to wire/cable and raceway hookups**, energize MCC circuitry and check each motor for proper phase rotation.

D. **Install approved overloads** after all wiring is checked.

3.4 ADJUSTING

A. **Adjust operating mechanisms** for free mechanical movement.

3.5 CLEANING

A. **Touch up scratched or marred surfaces** to match original finishes.

3.6 DEMONSTRATION

A. **Schedule an operational demonstration** with the Engineer and Owner with at least 7 days' advance notification. Demonstrate capability and compliance of MCCs and all associated controls with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace malfunctioning units with new units and proceed with retesting.

3.7 EXTRA MATERIALS

A. **Spare Fuses.** Furnish six spares of each type and rating of fuse and fusible devices required. Include spares for:

1. Control power fuses.
2. Fuses and fusible devices for fused circuit breakers.
3. Fuses for fusible switches.

B. **Spare Indicating Lights.** Furnish six of each type required.

C. **Touch-Up Paint.** Furnish three 1/2-pint containers.

END OF SECTION

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SECTION 26 27 16

INSTRUMENT PANELS AND CONSOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**

1. Section 26 05 12, "Wires, Cables, and Connectors."
2. Section 26 05 23, "Communication and Signal Cables."
3. Section 40 90 00, "Instrumentation Systems Basic Requirements."
4. Section 40 93 13, "Control Devices."
5. Section 40 95 33, "SCADA System"

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install instrument panels and consoles in accordance with the plans and as specified herein.

B. **Types.** The types of equipment specified in this section include the following:

1. Cabinets.
2. Consoles.
3. Components.
4. Shop fabrication.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to instrument control panel equipment. Provide components which have been UL listed and labeled.
4. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in the manufacture of instrument control panels whose products have been in satisfactory use in similar service for not less than 5 years.

2. Installer's Qualifications. Firm with at least 5 years of successful installation experience on projects with materials and equipment similar to items specified herein.

1.4 **SUBMITTALS**

A. **General.** Furnish manufacturer's product data, test reports, and materials certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.

B. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished or installed under this section.

1.5 **JOB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Storage and Protection**. The Contractor shall store the items furnished under this section until they can be installed. Such storage shall meet the requirements of the manufacturer and be approved by the Owner. Use all means necessary to protect the material of this section before, during, and after installation, and to protect the installed work and materials of all other trades.

1.7 **SPECIAL WARRANTY**

A. **General.** The Contractor shall retain the services of factory-trained servicemen to provide repair services for instrument control panels for 1 year commencing with the time the system equipment is complete and accepted by the Owner and including all repair and replacement parts needed during warranty period.

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Cabinets**

1. General. Comply with UL 50 "Cabinets and Enclosures" and NEMA ICS6 "Enclosures for Industrial Control and Systems."

2. Construction.

a. Stainless steel or painted steel as shown on the plans, 12 gauge.
b. Continuous welded seams, ground smooth.
b. Stainless steel hardware.
c. NEMA 12, 3R, or 4X as shown on the plans.

3. Doors.

a. Removable with full-length piano hinge.
b. Flange around all edges, 3/4 inch.
c. Padlockable.

d. Three-point latching mechanism on NEMA 12 and 3R enclosures.
e. Quick release latches on NEMA 4X enclosures.
f. Gasketed oil-resistant with stainless steel retaining strip.
g. Print pocket.

4. Mounting Panels.

a. Painted steel.
b. Bolted to enclosure with collar studs.

5. Finishes.

a. High-gloss white interior and mounting panels.
b. Polyester powder-coated exterior on NEMA 12 and 3R enclosures. Color to be selected during shop drawing approval.
c. Smooth brushed finish on NEMA 4X enclosures.

6. Manufacturers.

a. Subject to compliance with the requirements of this specification, available manufacturers of cabinets include, but are not limited to, the following:

1) Hoffman Engineering Co.

B. **Components**

1. Indicators and Recorders. As specified in Section 40 95 20, "Indicators and Recorders," and as shown on the contract drawings.
2. Annunciators. As specified in Section 40 95 21, "Annunciator," and as shown on the contract drawings.
3. Process Controllers. As specified in Section 40 93 00, "Process Controllers," and as shown on the contract drawings.
4. Telemetry Systems. As specified in Section 40 95 33 .03, "Telemetry Systems," and as shown on the contract drawings.
5. Pilot Devices, Relays, and Timers. As specified in Section 40 93 13, "Control Devices," and as shown on the contract drawings.
6. Wires and Connectors. As specified in Section 26 05 12, "Wires, Cables, and Connectors," and Section 26 05 23, "Communication and Signal Cables," and as shown on the contract drawings.
7. Power Supplies. As specified in Section 40 90 00, "Instrumentation Systems Basic Requirements," and as shown on the contract drawings.
8. Terminal Blocks. As specified in Section 40 90 00, "Instrumentation Systems Basic Requirements" and as shown on the contract drawings.
9. Ground Bus. Furnish each instrument panel and console with an isolated direct current (dc) ground bus and an equipment ground.
10. Miscellaneous Equipment.

a. Slotted plastic wiring ducts with snap-on covers.
b. Nylon spiral wrap wiring sheaths.
c. Nylon cable ties with screw anchors.

d. Nameplates as specified in Section 26 05 53, "Electrical Identification," and as shown on the plans.

C. **Shop Fabrication**

1. General.

a. Mount all internal components on subpanels.
b. Label all internal components.
c. Locate components to allow easy access and removal.
d. Provide 20-amp, 120-volt outlet in each panel.
e. Provide fluorescent light and switch where shown.
f. Locate front of panel devices as shown on the plans. Front of NEMA 4(X) panel devices shall have a sealing gasket installed between the device and the enclosure.
g. Provide 20 percent spare mounting space and 20 percent spare terminals for future expansion.

2. Wiring.

a. Route wiring horizontally or vertically in plastic wiring ducts.
b. Protect wiring to door mounted devices with spiral nylon sheath.
c. Separate alternating current (ac) and dc wiring a minimum of 4 inches.
d. Number all wires of each termination.
e. Terminate all external wiring on terminal blocks.
f. Color code all internal wiring as follows:

1) Direct Current Wiring. Blue.
2) Data Circuits. Orange.
3) Alternating Current Control. Red.
4) Externally Powered. Yellow.
5) Alternating Current Power. Black.
6) Neutrals. White.
7) Grounds. Green.

3. Manufacturers.

a. Subject to compliance with the requirements of this specification, available manufacturers of instrument panels and consoles include, but are not limited to, the following:

1) Adgo, Inc.
2) Panelmatic, Inc.

PART 3 - EXECUTION

3.1 **INSTALLATION**. Install equipment as indicated, in accordance with manufacturer's written instructions and with recognized industry practices.

A. **Examination**

1. Verification of Conditions. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Discrepancies. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved unless otherwise approved by the Engineer.

B. **Preparation**

1. Protection.

   a. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
   b. Provide blocking and cushioning materials to prevent damage during shipment.
   c. Provide temporary lifting lugs on shipping package as needed.
   d. Include approximately 1 pint of touch-up paint for each finish color in shipment.

2. Surface Preparation. The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

C. **Application**

1. Enclosure, Cabinets, Console Installation.

   a. Locate as shown on the contract drawings. Freestanding enclosures and consoles require a 4-inch concrete pad provided and installed by this Contractor.
   b. Floor-mounted control panels shall be installed utilizing all stainless steel hardware consisting of concrete anchor and machine bolt assembly.
   c. Wall mounted panels shall be offset from walls with standoffs. Wall mounted panels requiring freestanding mounting shall be supported on stainless steel strut with cross bracing and stainless steel hardware.
   d. Seal all conduit entrances watertight.

3.2 FIELD QUALITY CONTROL

A. **Tests.** Upon completion of all inspections and prior to acceptance by the Owner, perform the field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.3 DEMONSTRATION

A. **General.** When all required tests have been performed and prior to final approval a qualified representative of the supplier shall thoroughly demonstrate

to the Owner's personnel the operation of all items installed under this section in accordance with Section 40 90 00.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 53, "Electrical Identification," for requirements for legends to be engraved on wall plates.
4. Section 26 28 16, "Circuit and Motor Disconnects," for devices other than snap switches and plug/receptacle sets used as disconnects for motors.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install wiring devices in accordance with the plans and as specified herein.

1. This section includes the following:

a. Receptacles.
b. Ground fault circuit interrupter (GFCI) receptacles.
c. Plugs.
d. Plug connectors.
e. Wall plates.
f. Poke-through assemblies.
g. Telephone/data outlets.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install wiring devices in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Regulatory Requirements. Comply with provisions of the following codes.
2. National Fire Protection Association (NFPA) 70, "National Electrical Code (NEC)."
3. Underwriters' Laboratories, Inc. (UL) and National Electrical Manufacturers Association (NEMA) Compliance. Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.4 **SUBMITTALS**

A. **Transmittals.** Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Submit the following** in accordance with Conditions of Contract and Division 1 specifications sections:

1. Product data for each type of product specified.

1.5 **JOB CONDITIONS**

A. **Sequence and Scheduling**. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Deliver wiring devices and components** properly packaged in factory fabricated type containers.

B. **Store wiring devices and components** in original packaging and in a clean, dry space; protect from weather and construction traffic.

C. **Handle wiring devices and components** carefully to avoid breakages, impacts, denting, and scouring finishes. Do not install damaged equipment; replace/return damaged units to equipment manufacturer.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Manufacturers**

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Wiring Devices.

1) Bryant Electric Co.
2) Hubbell, Inc.
3) Pass & Seymour/Legrand.
4) Leviton.

B. **Wiring Devices**

1. General. Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Provide ivory color devices and wall plates except as otherwise indicated. Verify color selections with Engineer/Architect.

2. Receptacles.

   a. As scheduled in Table 1 in Part 3 below. Comply with UL 498 and NEMA WD 1.
   b. Receptacles, Industrial Heavy-Duty. Provide pin and sleeve design receptacles conforming to UL 498. Comply with UL 1010 where installed in hazardous locations. Provide features indicated.
   c. Ground Fault Interrupter (GFI) Receptacles. Provide "feed through" type ground fault circuit interrupter, with integral heavy duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2 3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943.

3. Plugs. 20 amperes, 125 volts, 3 wire, grounding, armored cap plugs, parallel blades with cord clamp, and 0.4-inch cord hole; match NEMA configuration with power sources.

4. Plug Connectors. 20 amperes, 125 volts, nylon body armored connectors, 3 wire, grounding, parallel blades, double wipe contact, with cord clamp, and 0.4-inch cord hole, match NEMA configuration to mating plugs. Arrange as indicated.

5. Switches.

   a. Combination Switch and Receptacle. General duty three-way quiet switch, 20 amperes, 120-277 volts ac, with toggle switch handle, and 3 wire grounding receptacle, 20 amperes, 120 volts, equip with plaster ears, and with break-off tab feature which allows wiring with separate or common feed, with NEMA Configuration 5-20R.

6. Heavy-Duty Weatherproof/Explosionproof Snap Switches. Provide factory-sealed snap switches suitable for Class 1, Division 1 and 2, Group C and D and NEMA 3 locations. Provide conduit hub sizes, poles, and multiple gangs as shown on the contract documents. Switches shall be Crouse-Hinds Model EDS, or equal.

C. **Wiring Device Accessories**

1. Wall Plates. Single and combination, of types and sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Provide an engraved legend plate labeled "GFI" for all receptacles protected by an upstream GFI receptacle or GFI circuit breaker. Conform to requirements of Section 26 05 53, "Electrical Identification." Provide plates possessing the following additional construction features:

    a. Material and Finish. Steel plate, galvanized.
    b. Material and Finish. Plastic, ribbed.
    c. Material and Finish. Plastic, smooth.

2. Weatherproof Covers. Weatherproof receptacle covers shall be rainproof while in use and shall be in full compliance with NEC Article 406.8. There shall be a neoprene gasket between the enclosure and the mounting surface and between the cover and base to ensure a proper seal. Switch covers shall be Crouse-Hinds DS185 or equal. Receptacle covers shall be Crouse-Hinds WLRD/WLRS or equal.

3. Weatherproof GFCI Receptacle Covers. Weatherproof covers for GFCI receptacles shall be rainproof while in use and shall be in full compliance with NEC Article 406.8. The covers shall be constructed of clear polycarbonate. The covers shall be hinged allowing them to swing open and closed. Provide molded polycarbonate inserts to plug unused cord openings in the cover and stainless steel mounting hardware. Provide standard box or FS box mounting provisions as necessary.

4. Telephone/Data Outlets. Provide flush mounted connecting block type with one or two 8-conductor jacks connected to quick connect terminals for easy termination. Provide outlets designed for use with single or duplex electrical faceplates.

    a. Single Outlet. AT&T 105AF or equal.
    b. Duplex Outlet. AT&T 106AFD or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Installation of Wiring Devices and Accessories**

1. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, and in accordance with recognized industry practices to fulfill project requirements.
2. Coordinate with other work, including painting, electrical boxes, and wiring installations, as necessary to interface installation of wiring devices with other work.

3. Mount all wall switches at 4'-0" above finished floor and all receptacles at 1'-6" above the finished floor unless otherwise noted.
4. Install wiring devices only in electrical boxes which are clean, free from building materials, dirt, and debris.
5. Install galvanized steel wall plates in unfinished spaces.
6. Install wiring devices after wiring work is completed.
7. Install wall plates after painting work is completed.
8. Install telephone/power service poles in accordance with final furnishings arrangement plan, plumb, true, and secure.
9. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque-indicating hand tool.

3.2 PROTECTION

A. **General.** Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

A. **Testing**. Prior to energizing circuits, test wiring for electrical continuity, and for short circuits. Ensure that proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

1. Test ground fault interruptor operation with both local and remote fault simulations in accordance with manufacturer recommendations.

3.4 **TABLES**

A. **Receptacles**

Table 1

Type	**Amperes**	**Volts**		**Hubble Catalog Number**	**Leviton Catalog Number**	**Bryant Catalog Number**
Duplex receptacles	20	125	NEMA 5-20R	5362	5362	5362
Clock receptacles	15	125	NEMA 5-15R	5235	28828GS	
Duplex GFCI receptacles	20	125	NEMA 5-20R	GF5362		
Duplex receptacle plates, flush or surface-mounted		Standard	S8	84003-40		
250-volt receptacles	30	250	NEMA 6-30R	9330	5372	9630FR
250-volt receptacle plates				S723	84028	

B. **Switches**

Table 2

Type	**Amperes**	**Volts**	**Hubble Catalog Number**	**Leviton Catalog Number**	**Bryant Catalog Number**
Single-pole switch	20	120-277	1221	1221	4901
Double-pole switch	20	120-277	1222	1222	4902
Three-way switch	20	120-277	1223	1223	4903
Four-way switch	20	120-277	1224	1224	4904
Switch plates, flush or surface-mounted			S-1	84001-40	

END OF SECTION

SECTION 26 28 00

OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 53, "Electrical Identification."

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install overcurrent protective devices (OCPDs) in accordance with the plans and as specified herein.

B. **Miscellaneous.** This section includes OCPDs rated 600 volts and below and switching devices commonly used with them.

C. **Panelboards, Switchboards, and Motor Control Centers**. Application, installation, and other related requirements for OCPD installations in distribution equipment are specified in other Division 26 sections.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with OCPDs in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Electrical Component Standard. Components and installation shall comply with National Fire Protection Association (NFPA) 70, "National Electrical Code (NEC)."

2. Listing and Labeling. Provide products specified in this section that are listed and labeled.

a. The terms "listed" and "labeled" shall be defined as they are in the NEC, Article 100.

B. **Single-Source Responsibility**. Obtain similar OCPDs from a single manufacturer.

1.4 SUBMITTALS

A. **General.** Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Submittals.** Submit the following in accordance with Conditions of Contract and Division 1 specification sections:

1. Product data for fuses, circuit breakers, and OCPD accessories specified in this section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver OCPDs and components** in factory-fabricated-type containers or wrappings, which properly protect devices from damage.

B. **Store OCPDs in original packaging** and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. **Handle OCPDs carefully** to prevent physical damage to circuit breakers and components. Do not install damaged circuit breakers; remove from site and replace damaged devices with new.

1.7 SPECIAL WARRANTY

Not used.

1.8 DEFINITIONS

A. **OCPD.** A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

B. **Ampere Squared Seconds**. An expression of available thermal energy resulting from current flow. With regard to current limiting fuses and circuit breakers, the ampere squared seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General

1. Provide OCPDs in indicated types, as integral components of panelboards, switchboards, and motor control centers; and also as individually enclosed and mounted single units.
2. Enclosures. National Electrical Manufacturers Association (NEMA) 250, "Enclosures for Electrical Equipment (1000 volts Maximum)."

B. Cartridge Fuses

1. NEMA Standard FU1, "Low Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

C. Molded Case Circuit Breakers

1. General. UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

2. Construction. Bolt-in type, except breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

3. Characteristics. Frame size, trip rating, and number of poles shall be as indicated on the drawings. The short circuit interrupting capacity shall be as shown in drawings for 480Y/277 volt systems and 10,000 amperes symmetrical for 208Y/120 volt and 120/240 volt systems, unless a greater rating is indicated.

4. Tripping Device. Quick-make, quick-break toggle mechanism with inverse time delay and instantaneous overcurrent trip protection for each pole.

5. Adjustable Instantaneous Trip Devices. Factory-adjusted to low trip setting current values.

6. Enclosure for Switchboard or Panelboard Mounting. Suitable for panel mounting in switchboard or panelboards where indicated.

7. Enclosure for Motor Control Center Mounting. Provide individual mounting where indicated.

8. Enclosure for Independent Mounting. NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

9. Combination Circuit Breakers and Ground Fault Circuit Interrupters. UL 943, "Ground Fault Circuit Interrupters," arranged for sensing and

tripping for ground fault current in addition to overcurrent and short circuit current. Provide features as follows:

a. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

b. Trip Setting for Ground Fault. 30 milliamperes.

10. Current Limiting Circuit Breakers. Arranged to limit let-through ampere squared seconds during fault conditions to a value less than the ampere squared seconds of one-half cycle wave of the prospective symmetrical fault current. The circuit breaker shall use no fusible devices in its operation. The current limiting characteristic shall be in addition to normal time delay and instantaneous trip characteristics.

11. Circuit Breakers with Solid-State Trip Devices. Provide indicated circuit breakers with solid-state trip devices having the following features:

a. Ambient Compensation. Trip device insensitive to temperature changes between 20 degrees Celsius (° C.) and +55° C.
b. Adjustability. Breaker ratings and trip settings shall be changeable by operation of controls on front panel of breaker, by change of plug-in element without removing breaker from mounting, or by a combination of the two methods.
c. Ground Fault Tripping. Adjustable for pickup and time delay values. Provide for indicated units. Include labeled light or indicator to indicate cause of trip.

D. **Insulated Case Circuit Breakers**

1. General. UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

2. Ratings. Continuous current, interrupting, and short time current ratings, and voltage and frequency ratings as indicated.

3. Operating Mechanism. Mechanically and electrically trip free, stored energy operating mechanism with the following features:

a. Moving Contacts Closing Speed. Independent of both control and operator.
b. Stored Energy Mechanism. Electrically charged, with provision for optional manual charging.

4. Circuit Breaker Trip Devices. Solid-state overcurrent trip device system that includes one integrally mounted current transformer or sensor per phase, a release mechanism, and the following features:

a. Functions. Long time delay, short time delay, and instantaneous trip functions, which are independent of each other in both action and adjustment.
b. Temperature compensation to ensure accuracy and calibration stability from -20° C. to +55° C.

c. Field adjustable, time current characteristics.
d. Current Adjustability. Effected by operating controls on front panel or by changing plug-in elements or current transformers or sensors.
e. Three bands for long time and short time delay functions marked "minimum," "intermediate," and "maximum."
f. Five pickup points, minimum, for long time and short time trip functions.
g. Six pickup points, minimum, for instantaneous trip functions.
h. Ground fault protection with at least three short time delay settings and three trip time delay bands. Adjustable current pickup.
i. Trip Indication. Labeled lights or mechanical indicators on trip device shall indicate type of fault causing breaker trip. If lights are used, integral power source shall maintain indication for 60 hours, minimum.

5. Auxiliary Contacts for Remote Indication. Where remote indication of breaker position is indicated, provide a spare auxiliary switch in addition to other auxiliary switches required for normal breaker operation. The spare auxiliary switch shall consist of two Type "a" and two Type "b" stages (contacts), wired to a terminal block in the breaker housing.

6. Circuit Breaker Features and Accessories. Include the following:

a. Operating Handle. Provide one for each manually operated breaker.
b. Electric Close Button. Provide one for each electrically operated breaker.
c. Indicating Lights. Contacts for "Breaker Open" and "Breaker Closed" for main and bus tie circuit breakers, and for other indicated breakers.

E. **OCPD Accessories**

1. Key Interlocks. Arrange interlocking so keys are held captive at devices indicated. Where future key interlocking provisions are indicated, provide necessary mountings and hardware as required for the future installation.
2. Labels. Install label inside enclosure identifying the type of OCPD installed, its overcurrent rating, its interrupt rating, and UL class. Where applicable, trip settings and time delays should be provided on permanent labels.
3. Adjustable Time Delay Undervoltage Trip Devices. For indicated OCPDs.
4. Shunt Trip Devices for Circuit Breakers. Where indicated, arrange to trip breaker from an external source of power through a control switch or relay contacts.

F. **Extra Materials**

1. For types and ratings required, furnish spare fuses, amounting to one fuse for every five installed fuses, but not less than one set of three of each type of fuse.

2.2 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Cartridge Fuses.

    a. Bussmann Div., Cooper Industries, Inc.
    b. Eagle Electric Mfg. Co., Inc.
    c. Ferraz Shawmut.
    d. General Electric Co.
    e. Littelfuse Inc.

2. Molded-Case Circuit Breakers.

    a. Eaton, Cutler Hammer Products.
    b. Crouse-Hinds Distribution Equipment.
    c. ABB Power Distribution, Inc.
    d. General Electric Co.
    e. Square D Co.

3. Combination Circuit Breaker and Ground Fault Circuit Interrupters.

    a. Eaton, Cutler Hammer Products.
    b. Crouse-Hinds Distribution Equipment.
    c. General Electric Co.
    d. Siemens Energy & Automation, Inc.
    e. Square D Co.

4. Molded-Case Current Limiting Circuit Breakers.

    a. Eaton, Cutler Hammer Products.
    b. General Electric Co.
    c. Siemens Energy & Automation, Inc.
    d. Square D Co.

5. Molded-Case Circuit Breakers with Solid-State Trip Devices.

    a. Eaton, Cutler Hammer Products.
    b. General Electric Co.
    c. Siemens Energy & Automation, Inc.
    d. Square D Co.

6. Insulated-Case Circuit Breakers.

    a. Eaton, Cutler Hammer Products.
    b. General Electric Co.
    c. Siemens Energy & Automation, Inc.

d. Square D Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Independently Mounted OCPDs.** Locate as indicated and install in accordance with manufacturer's written installation instructions.

B. **OCPDs in distribution equipment** shall be factory-installed.

3.2 IDENTIFICATION

A. **Identify components** in accordance with Section 26 05 53, "Electrical Identification."

3.3 CONTROL WIRING INSTALLATION

A. **Install wiring between OCPDs** and control/indication devices as specified in Section 26 05 12, "Wires, Cables, and Connectors," for hard wired connections.

3.4 CONNECTIONS

A. **Check connectors, terminals, bus joints**, and mountings for tightness. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.5 GROUNDING

A. **Provide equipment grounding connections** for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL

A. **Visual and Mechanical Inspection**. Include the following inspections and related work.

1. OCPD Ratings and Settings. Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.
2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
3. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

4. Check tightness of electrical connections of OCPDs with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Clean OCPDs using manufacturer's approved methods and materials.
6. Verify installation of proper fuse types and ratings in fusible OCPDs.

B. **Electrical Tests**. Include the following items performed in accordance with manufacturer's instructions:

1. Insulation resistance test of OCPD conducting parts. Insulation resistance less than 100 megohms is not acceptable.

2. Use primary current injection to check performance characteristics of trip units of insulated case circuit breakers and molded case breakers over 600 ampere frame size. Trip characteristics not falling within manufacturer's published time current characteristic tolerance bands when adjusted to approved parameters are not acceptable. Perform the following tests:

   a. Determine minimum pickup current acceptable per manufacturer's instructions.
   b. Determine long time delay at 300 percent pickup current.
   c. Determine short time pickup current and corresponding delay time.
   d. Determine ground fault current pickup and corresponding delay time.
   e. Determine instantaneous pickup current value.

3. Verify trip unit reset characteristics for insulated case circuit breakers.

4. Make adjustments for final settings of adjustable trip devices.

5. Activate auxiliary protective devices such as ground fault or undervoltage relays, to verify operation of shunt trip devices.

6. Check stored energy charging motors for proper operation of motor, mechanism, and limit switches.

7. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.

8. Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked open and opening attempts on locked closed devices including moveable barriers and shutters.

C. **Retest**. Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.

3.7 CLEANING

A. **Upon completion of installation**, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION

A. **Training**. Arrange and pay for the services of factory authorized service representatives to demonstrate OCPDs and train Owner's maintenance personnel.

B. **Conduct a minimum** of one-half day of training in operation and maintenance as specified under "Instructions to Owner Employees" in the "Project Closeout" section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.

C. **Schedule training** with at least 7 days' advance notification.

END OF SECTION

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SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Division 26 Basic Electrical Materials and Methods sections** apply to work of this section.

C. **The following Division 26 sections** contain requirements that relate to this section:

1. "Motor Disconnects."
2. "Motor Control Centers."
3. "Motor Controllers."

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install fuses in accordance with the plans and as specified herein.

B. **Extent of fuse work required by this section** is indicated by drawings, and by requirements of this section.

C. **Types of fuses specified** in this section include the following:

1. Class L time-delay.
2. Class RK1 and RK5 time-delay.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with fuses in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with applicable provisions of UL 198 for the class indicated. Provide overcurrent protective devices which are UL listed and labeled.
2. National Electrical Code (NEC) Compliance. Comply with NEC as applicable to construction and installation of fusible devices.
3. American National Standards Institute (ANSI) Compliance. Comply with applicable requirements of ANSI C97.1 "Low Voltage Cartridge Fuses 600 Volts or Less."

1.4 SUBMITTALS

A. **Transmittals.** Furnish manufacturer's product data, test reports, and materials certifications as required.

B. **Product Data**. Submit manufacturer's technical product data on fuses, including specifications, and electrical characteristics. In addition, include voltages and current ratings, interrupting ratings, current limitation ratings, time current trip and melt characteristic curves, and mounting requirements.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Deliver fuses and components** properly packaged in factory-fabricated-type containers.

B. **Store fuses and components** in original packaging and in a clean dry space; protect from weather and construction traffic.

C. **Handle fuses and components** carefully to avoid breakages, impacts, denting, and scoring finishes. Do not install damaged fuses; replace and return damaged units to equipment manufacturer.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **General**. Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time current and peak let through current characteristics indicated, which comply with manufacturer's standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations. See plans for specific type selections.

B. **Class L Time Delay Fuses**. Provide UL Class L time-delay fuses, with 200,000 RMS symmetrical interrupting current rating for protecting service entrances and main feeder circuit breakers.

C. **Class RK1 and RK5 Time Delay Fuses**. Provide UL Class RK1 and RK5 time-delay fuses, with 200,000 RMS symmetrical interrupting current rating for protecting motors and circuit breakers.

2.2 **EXTRA MATERIALS**

A. **Maintenance Stock, Fuses**. For types and ratings required, furnish additional fuses, amounting to one unit for every installed unit.

2.3 **MANUFACTURERS**

A. **Manufacturers**. Subject to compliance with requirements, provide fuses of one of the following:

1. Bussmann Div.; Cooper Industries.
Equipment Types: KRP-C, KTN-R, KTS-R, FRN-R, FRS-R, LPN-RK, LPS-RK.

2. Shawmut Div.; Gould Inc.
   Equipment Types: A4BY, A2K, A6K, TR, TRS, A2D, A6D.
3. Little Fuse Tracer.
   Equipment Types: KLPC, KLNR, KLSR, FLNR, FLSR, LLNRK, LLNRK, LLSRK.
4. Reliance Fuse; Brush Fuses.
   Equipment Types: LCL, NCLR, SCLR, ECNR, ECSR, LENRK, LESRK.

2.4 IDENTIFICATION

A. **General.** Provide fuse identification nameplates complying with Division 26 Basic Materials and Methods section "Electrical Identification." Tags shall be engraved plastic laminate and shall clearly identify fuse class, voltage, and current rating. Mount nameplate on switch or protected equipment cover.

PART 3 - EXECUTION

3.1 INSTALLATION OF FUSES

A. **Installation**. Install fuses as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and National Electrical Manufacturers Association (NEMA) standards for installation of fuses.

B. **Coordination**. Coordinate with other work, including electrical wiring, as necessary, to interface installation of fuses with other work.

C. **Install fuses** in fusible switches.

3.2 EXAMINATION

A. **General.** Examine areas and conditions under which fuses are to be installed, and notify Engineer/Architect, in writing, of conditions detrimental to proper completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to the Engineer/Architect.

3.3 FIELD QUALITY CONTROL

A. **General.** Prior to energization of fusible devices, test devices for continuity of circuitry and for short circuits. Replace malfunctioning units with new units, and then demonstrate compliance with requirements.

END OF SECTION

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SECTION 26 28 16

CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 12, "Wires, Cables, and Connectors."
4. Section 26 05 33, "Raceway."
5. Section 26 05 34, "Cabinets, Boxes, and Fittings."
6. Section 26 28 00, "Overcurrent Protective Devices."

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, tools, equipment, and material necessary to install circuit and motor disconnects in accordance with the plans and as specified herein.

B. **Extent of circuit and motor disconnect** switch work is indicated by drawings and schedules.

C. **Types of circuit and motor disconnect switches** in this section include the following:

1. Equipment disconnects.
2. Motor circuit disconnects.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with circuit and motor disconnects in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Code (NEC) Compliance. Comply with NEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.
2. Underwriters' Laboratories, Inc. (UL) Compliance. Comply with requirements of UL 98 "Enclosed and Dead Front Switches." Provide circuit and motor disconnect switches which have been UL listed and labeled.
3. National Electrical Manufacturers Association (NEMA) Compliance. Comply with applicable requirements of NEMA Standards Pub. Nos. KS 1, "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)," and 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

1.4 **SUBMITTALS**

A. **General.** Submit manufacturer's product data, test reports, and material certifications.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Deliver circuit and motor disconnect** switches properly packaged in factory-fabricated-type containers or wrappings which properly protect devices from damage.

B. **Store circuit and motor disconnect** switches in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. **Handle circuit and motor disconnect** switches carefully to prevent physical damage. Do not install damaged disconnect switches; remove from site and replace damaged devices with new.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Heavy-Duty Safety Switches**. Provide surface-mounted, heavy-duty-type, sheet steel enclosed safety switches, of types, sizes, and electrical characteristics as required for the indicated installation; fused, if noted on plan. Provide switches incorporating quick make, quick break type switches, so that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable and is padlockable in OFF position. Interlock enclosure door with operating handle such that the door cannot be opened with the switch closed. Provide an inconspicuous defect mechanism for use by maintenance personnel. Construct current carrying parts of high conductivity copper with silver tungsten type switch contacts; and positive pressure type reinforced fuse clips where fusible switches are specified or required by code. Provide NEMA Type 12 enclosures for all switches located in dry interior locations. Provide NEMA Type 4X stainless steel enclosures for all other locations.

B. **Fuses**. Provide fuses for safety switches, as noted on plans and as described in Section 26 28 00, "Overcurrent Protection Devices."

2.2 **MANUFACTURERS**

A. **Manufacturer**. Subject to compliance with requirements, provide circuit and motor disconnects of one of the following (for each type of switch):

1. Square D Company.
2. Cutler-Hammer, Inc.
3. General Electric Co.
4. Crouse-Hinds Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Install circuit and motor disconnect** switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and National Electrical Contractor's Association (NECA) "Standard of Installation," and in accordance with recognized industry practices.

B. **Coordinate circuit and motor disconnect** switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. **Locations of disconnect switches** as shown on the plans are approximate unless dimensioned. Install disconnect switches as close to the equipment served as practical, but at a readily accessible location with adequate working clearances to meet all NEC requirements.

D. **Provide a suitable means** for mounting all disconnect switches.

3.2 GROUNDING

A. **Provide equipment grounding connections**, tightened to ensure a permanent and effective ground, for all electrical disconnect switches.

3.3 FIELD QUALITY CONTROL

A. **Subsequent to completion of installation of electrical disconnect switches**, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest. Corrective action and repeated tests shall be accomplished at the Contractor's own expense.

END OF SECTION

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SECTION 26 29 00

LOW VOLTAGE MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. **Related Sections**. The following sections contain requirements that relate to this section.

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 28 16, "Circuit and Motor Disconnects," for fusible switches used in motor controllers.
4. Section 26 05 53, "Electrical Identification," for identification labels and warning signs for motor controllers and their components.
5. Section 26 05 26, "Grounding."
6. Section 26 28 00, "Overcurrent Protective Devices," for circuit breakers, fuses, and other similar devices used in motor controllers.
7. Section 26 24 19, "Motor Control Centers," for motor controllers used in motor control centers.
8. Section 40 93 13, "Control Devices," for control devices used in motor controllers.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install motor controllers in accordance with the plans and as specified herein.

B. **Extent of motor controller work** is indicated by drawings.

C. **Types of motor controllers** specified in this section include the following:

1. Manual.
2. Full voltage magnetic.
3. Reduced voltage solid state.
4. Adjustable frequency.
5. Combination.

D. **The harmonic requirements,** simulations, and testing required by this specification associated with adjustable frequency drives shall be the responsibility of the equipment supplier. It is not the intent of this specification to require the equipment supplier to limit harmonics or distortion due to sources other than those specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install motor controllers in accordance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Electrical Code Compliance. Comply with applicable local electrical code requirements of the authority having jurisdiction and National Electrical Code (NEC) Articles 220, 250, and 430, as applicable to installation and construction of motor controllers.
2. National Fire Protection Association (NFPA) Compliance. Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety Requirements for Employee Workplaces."
3. Underwriters' Laboratories, Inc. (UL) Compliance. Comply with applicable requirements of UL 486A and B, and UL 508, pertaining to installation of motor controllers. Provide controllers and components which are UL listed and labeled.
4. Institute of Electrical and Electronic Engineers (IEEE) Compliance. Comply with recommended practices contained in IEEE Standard 141, "Recommended Practice for Electric Power Systems for Industrial Plants," pertaining to motor controllers. Comply with applicable requirements of IEEE Standard 519-1992, "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems."
5. National Electrical Manufacturers Association (NEMA) Compliance. Comply with applicable requirements of NEMA Standard ICS 2, "Industrial Control Devices, Controllers and Assemblies," and Pub No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," pertaining to motor controllers and enclosures.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of motor controllers of types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years.
2. Installer's Qualifications. Firm with at least 5 years of successful installation experience with projects utilizing motor controller work similar to that required for this project.

C. **Factory Test**

1. Variable Frequency Drives (VFD).

    a. All control printed circuit boards shall be dynamically tested for a minimum of 22 hours while heat cycled 1 hour at each temperature setting from 32 degrees Fahrenheit (° F.) to 140° F.
    b. All controllers shall be subjected to Run-In Test with a properly sized motor and operated under cycling load conditions on a dynamometer. The controller shall be subjected to a Run-In Test that brings the controller to full rated temperature.
    c. The manufacturer shall provide certified copies of the factory test reports prior to shipment.

1.4 SUBMITTALS

A. **Submit the following** in accordance with conditions of Contract and Division 1 specification sections:

1. **Product Data**. Submit manufacturer's data and installation instructions on motor controllers. Include enclosure details which consist of exterior and interior front door with nameplate legends, interior door front and rear views and terminal block layout.
2. **Wiring Diagrams**. Submit power and control wiring diagrams for motor controllers showing connections to electrical power panels, feeders, and equipment. Control wiring diagrams shall be in ladder logic form. Differentiate between portions of wiring which are manufacturer installed and portions which are field installed.
3. **Motor Overloads**. Submit for approval motor overload sizes for each new motor starter furnished or existing motor starter modified. Overload size shall be based on actual motor nameplate data and power factor correction size where applicable. Submit for approval motor overload sizing criteria, manufacturer, support calculations, motor nameplate data, capacitor nameplate data, and manufacturer tables used. Include thermal overload compensation sizing information where motor(s) are operated at temperatures different than the motor controller(s).
4. **Maintenance Data**. Submit maintenance data and parts list for each motor controller and component, including "troubleshooting" maintenance guide. Include that data, product data, and shop drawings in a maintenance manual.
5. **Test Equipment Data**. Submit make, model, and performance specifications of testing equipment to be utilized for measuring harmonic distortion and power factor as required under Part 3 of this specification.
6. **Harmonic Analysis**. Submit a harmonic analysis of the installation to document compliance with IEEE 519-1992, "General Distribution Systems." The analysis shall include electrical one line drawings defining the resistance and impedance of each wire run and transformer leading to each adjustable frequency controller. Provide a computer generated Fourier analysis of the system and list the current and voltage amplitudes and phase angles of all harmonics up to the 25th harmonic at the point of common coupling (PCC). A summary shall detail the percent THD for voltage and current.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver motor controllers and components** properly packaged in factory fabricated type containers.

B. **Store motor controllers and components** in original packaging and in a clean dry space; protect from weather and construction traffic.

C. **Handle motor controllers and components** carefully to avoid breakages, impacts, and denting and scoring finishes. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.

1.7 **SPECIAL WARRANTY**

Not used.

1.8 **SEQUENCING AND SCHEDULING**

A. **Coordination.** Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of motor controllers with other work.

B. **Sequencing.** Sequence motor controller installation work with other work to minimize possibility of damage and soiling during remainder of construction period.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **General.** Except as otherwise indicated, provide motor controllers and ancillary components which comply with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for a complete installation.

B. **Fractional HP Manual Controllers**. Provide single phase fractional HP manual motor controllers, of sizes and ratings indicated. Equip with manually operated quick make, quick break toggle mechanisms; and with one piece melting alloy type thermal units. Controller to become inoperative when thermal unit is removed. Provide controllers with double break silver alloy contacts, visible from both sides of controller; green pilot lights, and switch capable of being padlocked OFF.

C. **Full Voltage Magnetic Controllers**. Provide full voltage alternating current magnetic controllers, consisting of magnetic contactor or contactors, and overload relay mounted in a common enclosure, of types, ratings, and NEMA sizes indicated. Equip reversing and two speed controllers with electrical and mechanical interlocks to prevent both contactors, forward and reverse or fast and slow, closing simultaneously. Equip controllers with solid-state overload relays. Provide a current sensor in each phase monitored by the solid-state overload. The overload relay shall provide running overload protection that yields a time-current curve closely paralleling that of the motor heating damage boundary, accurate to 2 percent. Running overload protection shall be switch selectable for the specific motor full load amperes within the starter range. Provide selectable class 10, 20, or 30 overload trip. Equip two speed controllers with two overload relays. Wire supplied control circuit per elementary diagrams provided. Provide three phase power monitor relay to protect the motors against the under voltage, loss of phase, and phase reversal. The relays shall be provided with automatic reset features.

D. **Variable Frequency Drives (VFD).**

1. Variable frequency drives shall be listed by Underwriters Laboratories (UL).
2. Construct the drives with three major sections: a full wave, 3 phase diode rectifier section to convert from alternating current (ac) to direct current (dc), a dc filter section to smooth the dc voltage, and a pulse width modulated IGBT 3 phase inverter section to provide a variable voltage, variable frequency output at a constant voltage to frequency ration. The output frequency range shall be a minimum of 6 to 120 hertz (Hz).
3. VFD's of less than 100 hp shall be 6 pulse or 12 pulse design with input line reactor or filters as indicated on the drawings and as required to meet input voltage and current harmonic distortion limits at PCC. **VFD's of 150 hp and larger shall be 18-pulse design** as indicated on the drawings.

4. General:

    a) Pump applications, **constant torque.**
    b) Motor type – standard NEMA design B.
    c) The controller shall not require an isolation transformer, even if motors are located in a damp area.
    d) All components shall include original manufacturer's identification and part number.
    e) High power factor input with minimal line distortion, notching or harmonics.
    f) Basic drive design shall be pulse width modulated with carrier frequency adjustable to 10 KHZ.
    g) The controller shall comply with Federal Communications Commission requirements under Part 15 Rules for Radio Frequency Interference and IEEE 519 for 5% (voltage and current) maximum harmonics with 18 pulse drives.
    h) All controllers shall be subjected to a 22-hour burn in test.

5. Environmental

    a) Ambient operating temperature range – 10 to 40^{o} C.
    b) Humidity: 5 to 95%, non-condensing.
    c) Altitude: 0 to 3300 feet above sea level.

6. Electrical

    a) Input line voltage: 480 volts, 3-phase, 60 Hz, within $\pm$ 10% voltage fluctuations.
    b) Motor nameplate voltage: 460 volts (+/- 10% fluctuations), 3-phase, 60Hz.
    c) Output frequency range: 0 to 320 Hz.
    d) Minimum drive efficiency: 95% at 100% speed.
    e) Current rating: **Continuous115% of connected motor's actual full load ampere (output rated current) at full speed.**
    f) Overload rating: 150% for constant torque at 1 minute.
    g) Input line fuses.
    h) External control circuit voltage: 120 V AC, maximum.

7. The controller shall include the following protective features with status indicators:

a) Overvoltage.
b) Undervoltage.
c) Overcurrent.
d) Ground fault.
e) Over temperature.
f) Phase loss/blown fuse.
g) Running overload protection.
h) Common alarm contact for external user.
i) Line circuit breaker.
j) 5% in-line reactors and/or harmonic filters for 6-pulse drives as shown on the electrical one-line drawings.

8. The power circuit design shall be such that the following conditions will not damage the drive:

    a) Single or three-phase fault from line-to-line or line-to-ground.
    b) Opening of all three phases during operation by disconnect switch at motor location.

9. Indicator light safety feature shall indicate when DC bus is energized and capacitors are charged.

10. Internal calibration adjustments: Digital keypad and display module shall provide parameter settings, adjustment and monitoring of control functions and faults. Display messages shall be in English.

    a) Minimum speed.
    b) Maximum speed.
    c) DC boost.
    d) Acceleration/deceleration rates.
    e) Stop mode (ramp or coast).
    f) Automatic restart after fault trip with lockout after five attempts to restart.
    g) Anti-windmilling adjustable brake time.
    h) Adjustable volts/Hertz.

11. Unit mounted operator controls:

    a) Hand-Off-Auto switch.
    b) VFD-Bypass selector switch and Bypass light (Only where shown on the one-line diagrams).
    c) Speed adjustment potentiometer.
    d) Indicating speed meter.
    e) Power ON and OFF lights.
    f) VFD fail light
    g) Motor high temp light.
    h) Additional operator controls and alarm lights as shown on the drawings.

12. Provision for remote external controls:

    a) Two wire ON-OFF control.

b) Speed adjustment, analog input (4-20 MADC).
c) Speed select, local-remote selector switch.

13. Interlocks

a) The unit shall input motor winding high temperature alarm. Upon activation of alarm, the pump shall stop. The pump shall automatically reset when alarm is removed.
b) Where other process alarms (high pressure, temp, vibration, etc.) are connected to the VFD, the unit shall shutdown after a field adjustable time delay with a lockout function. Refer to wiring diagrams for additional interlock and device requirements.

14. Bypass

a) Provide heavy duty solid-state bypass starters for the selected VFDs as shown on the electrical one-line drawings.
b) All contactors used in the bypass operation shall be NEMA rated.

15. Short Circuit Ratings:

a) Refer to the electrical drawings, one-line diagrams.

E. **Solid State Reduced Voltage Starters**.

1. Solid-state starter shall be listed by Underwriters Laboratories (IUL).

2. Construct controllers with silicon controlled rectifiers (SCRs) for controlling motor voltages during acceleration. Provided on-board diagnostics with light emitting diodes (LEDs) indicated fault conditions.

3. General:

a) Pump applications, constant torque.
b) Motor type – standard NEMA design B.
c) The solid-state controller shall be a heavy duty, rugged 6-SCR device fully rated for 50° C. Heat sinks or other power section components shall be housed in the same enclosures with controller.
d) The starter control shall be microprocessor-based.
e) All components shall include original manufacturer's identification and part number.
f) The controller shall comply with NEMA ICS-2-23-0 and IEEE Std. 472 for noise and RF immunity.
g) Fully rated metal oxide varistors (MOVs) and RC snubbers shall be provided for transient protection.
h) Input isolation magnetic contractor.
i) Pump Control: This function shall be used to reduce surges in pumping system during starting or stopping of pump by smoothly accelerating and decelerating the motor. The microprocessor shall analyze the motor variables and shall generate control commands, which will control the motor in such a way to reduce the possibility of surges occurring in the system.

Starting time shall be adjustable from 2 to 30 seconds; stopping shall be adjustable from 2 to 120 seconds. Both starting time and stopping time shall be independently adjustable.

j) Shorting Contractors: Internal contractor shall be provided to allow cross the line operation when the pump reaches full speed. At full speed condition the SCR's will remain in standby mode, operating in parallel with the contractor. Open circuit transition between SCR's and contractor shall not be acceptable for providing this function.

4. Environmental:

   a) Ambient operating temperature range – 10 to 40° C.
   b) Humidity: 5 to 95 %, non-condensing.
   c) Altitude: to 3,300 feet above sea level.

5. Electrical:

   a) Input line voltage: 480 volts, 3-phase, 60 Hz within ± 10% voltage fluctuations.
   b) Motor nameplate voltage: 460 volts, 3-phase, 60 Mz, horsepower as indicated on the Drawings.
   c) Overload capability: 400% for minimum of 30 seconds.
   d) Minimum peak inverse voltage (P.I.V.): 1,400 at 480 V.

6. The unit shall include the following protective features with status indicators.

   a) Overvoltage.
   b) Under voltage.
   c) Overcurrent.
   d) Shirted SCR.
   e) Over temperature.
   f) Phase loss/blown fuse.
   g) Running overload protection.
   h) Common alarm contact for external use.

7. The power circuit design shall be such that the following conditions will not damage the unit.

   a) Single or three-phase fault form line-to-line or line-to-ground.
   b) Opening of all three phases during operation by disconnect switch at motor locations.

8. Internal calibration adjustments:

   a) Initial torque.
   b) Acceleration ramp.
   c) Deceleration ramp.
   d) Pump status day contacts for external use.

9. Unit mounted operator controls:

a) Hand-off-Auto switch.
b) Power ON light
c) Pump ON/OFF lights
d) Fault indicating lights
e) Additional operator controls and devices as shown on the drawings.

10. Refer to wiring diagrams for additional interlocks and device requirements.

11. Short circuit ratings:

a) Refer to drawings, one-line diagram.

F. **Reduced Voltage Magnetic Controllers**. Provide reduced voltage autotransformer type magnetic controllers of sizes, ratings, electrical characteristics, and NEMA sizes indicated. Equip controllers with quantity of block type inverse time overload relays indicated.

1. Construct controllers with three pole contactors, closed transition, 3-phase starting autotransformer, adjustable timer and a three-pole overload relay. Construct autotransformer with voltage taps at 65 percent and 80 percent of full line voltage. Provide duty cycle of 15 second operation out of each 4 minutes for 1 hour followed by a rest period of 2 hours.

2. The units shall include additional run contactors for connection of power factor correction capacitors to the circuit when full voltage condition is reached.

G. **Combination Controllers**. Provide combination controllers consisting of a controller as described above (i.e., full voltage magnetic, reduced voltage, VFD, etc.) and a fused switch or thermal magnetic molded case circuit breaker mounted in a common enclosure. Provide external operator handles for the switches or breakers. Design the handle with an up-down motion and with the down position indicating OFF. Construct the handles to permit locking in the OFF position with up to three padlocks. Standard controls for a combination controller shall include an H-O-A selector switch, fused control power transformer, elapsed time meter, a red run and green stop lights unless indicated otherwise on the plans. Two N.O. auxiliary contacts for external use and a phase monitor relay shall also be provided for each controller unless otherwise noted. The phase monitor relays shall protect the motors against low voltage, loss of phase or phase reversal conditions. The units shall be provided with built-in time delay on trip and onto restart functions. The Wire supplied control circuit per elementary diagrams provided. Unless stipulated to be a motor controller only, all controllers are assumed to be combination type.

H. **Control Components**. Provide control components as specified in Section 40 93 13, "Control Devices," and as shown on the drawings.

I. **Enclosures**. Controllers shall be mounted inside motor control centers or as indicated on the drawings.

1. All accessories, including harmonic filters and line reactors, shall be provided in the controller enclosure. Power factor correction capacitors shall be mounted above MCC's. If an additional enclosure is required, it shall be approved by the Engineer. Additional enclosures shall be constructed equal to the controller enclosure. All additional interconnections, mounting, and installation hardware and provisions, including wire and conduit between enclosures, shall be included.

J. **Harmonic Distortion Requirements**

1. Harmonic distortion due to the individual Variable frequency drive or solid-state reduced voltage controllers and the total load of all the VFD or solid-state reduced voltage controllers shall not exceed the requirements of IEEE 519-1992. The PCC shall be the bus of the motor control center feeding the controllers.
2. The maximum allowable current distortion limits shall be as recommended in Table 10.3, "Current Distortion Limits for General Distribution Systems," in IEEE 519-1992. The available short circuit current at the PCC shall be defined as the maximum short circuit current available at the motor control center feeding the controller. Loads not connected to the same bus defined as the PCC shall not be considered in the evaluation.
3. Under normal operating conditions when minimum of one VFD of each set of two pumps are operating, the line harmonics introduced into the power system from AC drives for both voltage and current shall be within the limits as defined in IEEE-519 (1992 edition).
4. The maximum allowable total harmonic distortion (THD) of the voltage and current at the PCC shall not exceed 5 percent.
5. The power factor (displacement and normal) at full load shall be greater than or equal to 92 percent lagging for each unit.

2.2 EXTRA MATERIALS

A. **Maintenance Stock, Fuses.** For types and ratings required, furnish additional fuses, amounting to one unit for every installed unit.

1. 1 (or 1 per 10 whichever is greater) of each size and type of push buttons and selector switches.
2. 1 (or 1 per 10 whichever is greater) of each size and type of contact blocks.
3. 1 (or 1 per 10 whichever is greater) of each size and type of pilot lights and illuminated buttons.
4. 10 (or 1 per 10 whichever is greater) of each size and type of lamp.

B. **Provide one spare** VFD operator interface for each type provided by each vendor (minimum one per vendor).

C. **Provide one spare** main control board for every three VFD provided by each vendor (minimum one per vendor).

2.3 EQUIPMENT/SYSTEM IDENTIFICATION

A. **Provide** equipment/system identification nameplates complying with Section 26 05 53, "Electrical Identification," in accordance with utilization equipment name and its location. Tags shall be engraved plastic laminate.

2.4 MANUFACTURERS

A. **Manufacturers.** Subject to compliance with requirements, provide motor controllers by the following:

1. Eaton, Cutler-Hammer Corp.

B. Alternate Bid Equipment

1. Allen Bradley
2. General Electric Co.
3. Siemens

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General.** Examine areas and conditions under which motor controllers are to be installed, and notify the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. **Miscellaneous**

1. Install motor controllers where indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, complying with applicable requirements of NEC, UL and NEMA standards, to ensure that products fulfill requirements.
2. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the NEC.
3. Install fuses of sizes indicated in each fusible disconnect switch.
4. Wall mount the enclosures using spacers or standoffs (1/4 inch minimum).
5. Provide auxiliary motor starter, overload and H-O-A selector switch contacts as required. Verify wiring supplied of control circuit is per elementary diagrams provided.
6. Pay for the services of the VFD manufacturer’s employed field service engineer to assist in the installation and start up of the VFD’s. The field service personnel shall be factory trained with periodic updates and have experience with the same model of VFD as on the job site.

3.2 **FIELD QUALITY CONTROL**

A. **General**

1. Prior to energization of motor controller equipment, check with ground resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure that requirements are fulfilled.
2. Prior to energization, check circuitry for electrical continuity and for short circuits.
3. Ensure that direction of rotation of each motor fulfills requirements.

B. **VFD Testing**. Testing shall be witnessed by the Engineer. The Engineer shall be notified at least 7 days in advance of testing. The current and voltage harmonic distortion and power factor shall be monitored at the motor control center feeding the controller being tested with a BMI Model 3030 harmonic analyzer or equal. The field tests shall be performed by an independent testing organization. Submit the experience record of the test organization for approval by the Engineer and a plan for the on-site tests. Data shall be collected for each motor at rated load and speed with all motors on the local bus running at rated load and speed. Sufficient data shall be collected to prepare a report to compare the harmonic content of the system to the calculated values in the analysis submitted in accordance with subpart 1.4, paragraph A.6 of this specification.

3.3 **GROUNDING**. Provide equipment grounding connections for motor controller equipment and enclosure as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounding.

3.4 **ADJUSTING AND CLEANING**

A. **Adjust** operating mechanisms, where necessary, for free mechanical movement.

B. **Touch up** scratched or marred enclosure surfaces to match original finishes.

3.5 **DEMONSTRATION**. Upon completion of installation of motor controller equipment and electrical circuitry, energize controller circuitry and demonstrate functioning of specified features on each equipment item in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

3.6 **TRAINING**. Provide one day of on-site training for the plant's staff on variable frequency drives and solid-state starters. The training shall be conducted by the factory-trained instructor or field engineer.

END OF SECTION

SECTION 26 35 33

POWER FACTOR CORRECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods.
3. Section 26 05 53, "Electrical Identification."
4. Section 26 05 26, "Grounding."
5. Section 26 28 00, "Overcurrent Protective Devices."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install power factor correction capacitors in accordance with the plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install power factor correction capacitors in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Electrical Code Compliance. Comply with applicable local electrical code requirements of the authority having jurisdiction and National Electrical Code (NEC) as applicable to construction and installation of power factor correction equipment.
2. Underwriters' Laboratories, Inc. (UL) Compliance. Comply with applicable requirements of UL Standards 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors," and 810, "Capacitors." Provide power factor correcting equipment and associated equipment which are UL listed and labeled.
3. Institute of Electrical and Electronic Engineers (IEEE) Compliance. Comply with applicable recommended installation practices of IEEE Standard 241, "Recommended Practice for Electric Power Systems in Commercial Buildings," pertaining to power factor correcting equipment.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of power factor corrective equipment of types, sizes, and ratings required, whose products have been in satisfactory use in similar service

for not less than 5 years.

2. Installer's Qualifications. Firm with at least 2 years of successful installation experience with projects utilizing power factor correction equipment and work similar to that required for this project.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** in accordance with conditions of contract and Division 1 specification sections and Section 26 00 01, "Basic Electrical Requirements."

1. Product Data. Submit manufacturer's data on power factor correction equipment.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** power factor corrective capacitors in factory fabricated type containers or wrappings which properly protect capacitors from damage.

B. **Store** power factor corrective capacitors in clean dry space in original containers or wrappings. Protect products from weather, damaging fumes, construction traffic, and debris.

C. **Handle** power factor corrective capacitors carefully to prevent physical damage to capacitors and components. Do not install damaged capacitors; replace damaged capacitors with new.

1.7 SPECIAL WARRANTY

Not used.

1.8 SEQUENCE AND SCHEDULING

A. **Coordinate** with other electrical work including, but not limited to, cables/wires, raceways, and electrical boxes and fittings to properly interface installation of power factor correction capacitor work with other work.

PART 2 - PRODUCTS

2.1 CAPACITORS

A. **General**. The power capacitors shall be 3 phase, 3 bushing, with nonflammable, biodegradable low toxicity dielectric fluid containing no polychlorinated biphenyls (PCBs) and have an electrically welded, hermetically sealed steel case. The dielectric design shall consist of metalized electrodes vacuum deposited on both sides of a proper substrate, with polypropylene dielectric. Equip with solderless connecting terminal lugs.

B. **Discharge Resistors**. Each capacitor shall have internal carbon film discharge resistors capable of reducing the trapped charge potential to 50 volts or less within 1 minute after de-energization.

C. **Fuses**. Each capacitor shall have current limiting fuses (200,000 amp interrupting capacity) in each phase and a blown fuse indicator for each fuse.

D. **Enclosures**. Indoor enclosures shall be rated National Electrical Manufacturers Association (NEMA) 12 dusttight, and outdoor enclosures shall be rated NEMA 3R raintight. Enclosures shall be equipped with heavy-duty lugs or eye bolts for lifting. Enclosures shall be painted with a rust resisting primer and a modified alkyd enamel, American National Standards Institute (ANSI) No. 61 outdoor (light gray) finish coat.

2.2 **SIZING**

A. **Kilovar ratings** for motor individual power factor correction shall be as recommended by the motor manufacturer, resulting in an improved motor power factor of between 93 and 96 percent at full load without causing system instability for all operating conditions.

B. **Where the capacitor is installed** on the load side of the motor overload device, the rating of the motor overload device shall be based on the improved power factor of the motor circuit.

2.3 **MAINTENANCE**

A. **Maintenance Stock Fuses**. For types and ratings required, furnish additional fuses, amounting to one each for every installed unit.

2.4 **MANUFACTURERS**

A. **Manufacturers**. Subject to compliance with requirements, manufacturers offering power factor correction equipment/systems include the following:

1. American Switchgear.
2. Sprague.
3. General Electric.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **Examine areas and conditions** under which power capacitors and components are to be installed and notify the Engineer/Architect in writing of conditions detrimental to proper completion of work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. **Provide and install** housekeeping pads for all floor mounted power factor correction capacitors.

C. **Install capacitors** at the motor starter or motor locations or where shown on the

drawings. If not shown on drawings, install as physically proximate to motor as possible.

D. **Securely fasten** equipment to pad on which they are mounted.

E. **Furnish and install** power capacitors on all motors sized 25 horsepower and larger.

F. **Capacitors** shall not be installed between controller and motor on motors controlled by solid-state variable speed drives or solid-state starters. Where needed, capacitors shall be coordinated with the drive manufacturer for installation on the line side of the controller.

G. **Size, furnish,** and install wire and conduit in accordance with the NEC for the capacitor installation.

3.2 FIELD QUALITY CONTROL

A. **Prior to energization** of circuitry, check all accessible connections and test all connections to demonstrate capability and compliance with requirements.

3.3 CLEANING

A. **Touch up** scratched or marred surfaces to match original finishes.

3.4 GROUNDING

A. **Provide equipment grounding** connections for power capacitors as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounds.

3.5 DEMONSTRATION

A. **Subsequent to wire and cable hook-ups**, energize power capacitors and demonstrate required functioning. Where necessary, correct or replace malfunctioning units and then retest to demonstrate compliance.

END OF SECTION

SECTION 26 43 01

TRANSIENT VOLTAGE SURGE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections apply to this section.

1. Section 26 24 13 "Switchboards" for factory-installed TVSSs.
2. Section 26 24 19 “Motor Control Centers” for factory installed TVSSs.
3. Section 26 24 16 "Panelboards" for factory-installed TVSSs.

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and material necessary to install TVSSs in accordance with the plans and as specified herein.

B. **Extent of TVSS work is indicated** on the drawings.

C. **Definitions**

1. **TVSS**. Transient voltage surge suppressor.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with TVSSs in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **TVSSs shall be manufactured, tested, and installed** in accordance with the requirements of the following standards.

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).

   a. C62.11-1999, "Standard for Metal Oxide Surge Arresters for AC Power Circuits."
   b. C62.41.1-2002, "Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits."
   c. C62.41.2-2002, "IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits.
   d. C62.45-2002, "Guide on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits."

2. National Electrical Manufacturers Association (NEMA) LS-1 1992, "Low Voltage Surge Protective Devices."

3. National Fire Protection Association (NFPA).

a. NFPA 70-2005, "National Electrical Code."
b. NFPA 75-2003, "Protection of Electronic Computer/Data Processing Equipment."
c. NFPA 780-2004, "Standard for the Installation of Lightning Protection Systems."

4. Underwriters' Laboratories, Inc. (UL).

a. UL 94-1996, "Tests for Flammability of Plastic Materials."
b. UL 746-B-1996, "Polymetric Materials Long-Term Property Evaluations."
c. UL 1283-1998, "Electromagnetic Interference and Radio Interference Filters."
d. UL 1449-1996, "Transient Voltage Surge Suppressors."

C. **Compliance**

1. TVSSs shall be tested, listed, and labeled by UL.

a. Units shall bear the UL 1449 listing as a TVSS and the UL 1283 listing as an electromagnetic interference filter.
b. Units shall have a UL-listed short circuit current rating (SCCR) equal to or greater than the equipment to which they are connected or equal to or greater than the fault current available on the system at the point to ehich they are connected, whichever is greater.

2. TVSSs shall be identified and labeled for the location category for which they are designed, as defined in IEEE Standard C62.41.

3. TVSSs shall successfully pass the life cycle tests prescribed in ANSI/IEEE C62.41.

4. Factory Prototype Tests. Each design configuration shall have the following tests, for which certified documents shall be submitted.

a. Single-pulse surge current capacity test in accordance with NEMA LS-1, utilizing one ANSI/IEEE C62.41 Category C1 surge to benchmark the unit's suppression voltage, followed by a second Category C1 surge to verify that the unit suppression voltage does not vary more than 10 percent from that of the benchmark surge.
b. Minimum repetitive surge current capacity test, utilizing one ANSI/IEEE C62.41 Category C1 surge to benchmark the unit's suppression voltage, followed by a repetitive number of ANSI/IEEE C62.41 Category C3 surges, followed by a second Category C1 surge, to verify that the unit suppression voltage does not vary more than 10 percent from that benchmark surge.
c. Duty cycle test to obtain the UL 1449 suppression voltage rating shall be performed on a prototype unit by UL utilizing their standard duty cycle testing procedures.

D. **Source Limitations**. Obtain TVSSs and accessories through one source from a single manufacturer.

E. **Electrical Components, Devices, and Accessories**. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 **SUBMITTALS**

A. **Product Data**. For each type of product proposed. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. **Product Certificates**. For TVSSs, signed by product manufacturer certifying compliance with the following standards.

1. UL 1283.
2. UL 1449.
3. NEMA L-S1.

C. **Operation and Maintenance Data**. For TVSSs to include in operation and maintenance manual.

1.5 **JOB CONDITIONS**

Not Used.

1.6 **DELIVERY**, **STORAGE**, **AND HANDLING**

A. **Deliver TVSSs properly packaged** in factory-fabricated-type containers or wrappings, which properly protect devices from damage.

B. **Store TVSSs in original packaging** and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping. Maintain storage temperatures within the limits of -40° F. to 185° F.

C. **Handle surge TVSSs carefully** to prevent physical damage. Do not install damaged equipment. Remove from site and replace damaged devices with new.

1.7 **SPECIAL WARRANTY**

A. **Special Warranty**. Manufacturer's standard form in which manufacturer agrees to repair or replace components of TVSSs which fail in materials or workmanship within 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Cutler-Hammer, Inc.; Eaton Corporation.
2. General Electric Company.

3. Liebert Corporation; a Division of Emerson.
4. Siemens Energy & Automation, Inc.
5. Square D; Schneider Electric.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. **Service entrance TVSS shall be installed** as an integral part of proposed switchboard.

B. **TVSS Description**. Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories.

1. Fuses, rated at 200-kiloampere (kA) interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral circuit breaker disconnect.
4. Arrangement with wire connections to phase bus, neutral bus, and ground bus.
5. LED indicator lights for power and protection status.
6. Audible alarm, with silencing switch, to indicated when protection has failed.
7. One set of dry contacts rated at 5 A and 250 Vac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.

C. **Peak Single-Impulse Surge Current Rating**. 240kA per phase.

D. **Connection Means**. Direct bus.

E. **Protection modes and UL 1449** second edition SVR for grounded wye circuits with voltages of 480Y/277, 3-phase, 4-wire circuits shall be as follows.

1. Line to Neutral. 800 V
2. Line to Ground. 800 V
3. Neutral to Ground. 800 V
4. Line to Line. 1800V

2.3 PANELBOARD SUPPRESSORS

A. **TVSS Description**. Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories.

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral circuit breaker disconnect.
4. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
5. LED indicator lights for power and protection status.
6. Audible alarm, with silencing switch, to indicate when protection has failed.
7. One set of dry contacts rated at 5 A and 250 Vac for remote monitoring of protection status. Coordinate with building power monitoring and control system.

B. **Peak Single-Impulse Surge Current Rating**. 80kA per phase.

C. **Protection modes and UL 1449** second edition SVR for grounded wye circuits with voltages of 208Y/120V, 3-phase, 4-wire circuits shall be as follows.

1. Line to Neutral. 400V
2. Line to Ground. 400 V
3. Neutral to Ground. 400 V

D. **EMI/RFI Filter**. Minimum filter noise attenuation shall be as follows.

Frequency	Attenuation
50 kHz	32 db
100 kHz	50 db
1 MHz	39 db
10 MHz	46 db
100 MHz	38 db

2.4 MOTOR CONTROL CENTER SUPPRESSORS

A. **TVSS Description**. Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories.

1. Fuses, rated at 200-kiloampere (kA) interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral circuit breaker disconnect.
4. Arrangement with wire connections to phase bus, neutral bus, and ground bus.
5. LED indicator lights for power and protection status.
6. Audible alarm, with silencing switch, to indicated when protection has failed.
7. One set of dry contacts rated at 5 A and 250 Vac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.

B. **Peak Single-Impulse Surge Current Rating**. 120kA per phase.

C. **Connection Means**. Direct bus.

D. **Protection modes and UL 1449** second edition SVR for grounded wye circuits with voltages of 480Y/277, 3-phase, 4-wire circuits shall be as follows.

1. Line to Neutral. 800 V
2. Line to Ground. 800 V
3. Neutral to Ground. 800 V
4. Line to Line. 1800V.

2.5 ENCLOSURES

A. **NEMA 250 with type matching** the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF TVSSs

A. **Install TVSS at service entrance** on load side, with ground lead bonded to service entrance.

B. **Provide integral TVSSs for proposed switchboards**, panelboards, and motor control centers where indicated on the drawings.

3.2 FIELD QUALITY CONTROL

A. **Testing**. Perform the following field tests and inspections and prepare test reports.

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1. Complete start-up checks according to manufacturer's written instructions.
2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" section. Certify compliance with test parameters.

B. **Remove and replace malfunctioning units** and retest as described above.

END OF SECTION

SECTION 26 56 71

LUMINAIRES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. **Related Sections**. The following Division 26 sections contain requirements that relate to this section:

1. Section 26 00 01, "Basic Electrical Requirements."
2. Section 26 00 02, "Basic Electrical Materials and Methods."
3. Section 26 05 12, "Wires, Cables, and Connectors," for wiring used in tandem-wired luminaires.
4. Section 26 05 29, "Supporting Devices."
5. Section 26 56 00, "Exterior Light Fixtures and Lamps," for site, parking lot, roadway, and other elevated exterior lighting.

1.2 DESCRIPTION OF THE WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install luminaires in accordance with the plans and as specified herein.

B. **Types of luminaires** in this section include the following:

1. LED.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work to furnish and install luminaires in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Electrical Code Compliance. Comply with applicable local code requirements of the authority having jurisdiction and National Electrical Code (NEC) as applicable to installation and construction of luminaires.
2. National Electrical Manufacturers Association (NEMA) Compliance. Comply with applicable requirements of NEMA Standard Publication NO. LE 1 and LE 2 pertaining to lighting equipment.
3. Underwriters' Laboratories, Inc. (UL) Compliance. Comply with UL standards, including UL 486A and B, pertaining to luminaires. Provide luminaires and components which are UL listed and labeled.
4. Certified Ballast Manufacturers (CBM) Labels. Provide fluorescent lamp ballasts which comply with CBM Association standards and carry the CBM label.

5. Special Listing and Labeling. For use in damp or wet locations, underwater, and recessed in combustible construction, provide luminaires specifically listed and labeled for such use. Provide luminaires for use in hazardous (classified) locations that are listed and labeled for the specific hazard.

   a. Luminaires for hazardous locations shall conform to UL 844 and shall have Factory Mutual Engineering and Research Corporation (FM) certification for the indicated class and division of hazard.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of luminaires of sizes, types, and ratings required, whose products have been in satisfactory use in similar service for not less than 7 years.
2. Installer's Qualifications. Firms with at least 5 years of successful installation experience on projects with luminaire work similar to that required for this project.

1.4 SUBMITTALS

A. **General**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Product Data. Submit manufacturer's product data and installation instructions on each type luminaire and component including lamp data.

2. Maintenance Data. Submit maintenance data and parts list for each luminaire and accessory including troubleshooting maintenance guide. Include that data, product data, and shop drawings in a maintenance manual in accordance with general requirements of Division 1.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver luminaires in factory-fabricated containers** or wrappings which properly protect luminaires from damage.

B. **Store luminaires in original wrappings** in a clean dry space. Protect from weather, dirt, fumes, water, construction debris, and damage.

C. **Handle luminaires carefully to prevent damage**, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.7 SPECIAL WARRANTY

A. **Special Project Warranty**. Submit a warranty, mutually executed by manufacturer and installer, agreeing to replace rechargeable batteries that fail in materials or workmanship within the special project warranty period specified

below. This warranty is in addition to, and not a limitation of, other rights and remedies the Owner may have under the Contract Documents.

1. Self-Powered Exit Sign Batteries. 3 years beginning on the date of substantial completion. A full warranty shall apply for the first year of the period, and a prorated warranty for the last 2 years.
2. Emergency Egress Lighting Unit Batteries. 3 years beginning on the date of substantial completion. A full warranty shall apply for the first year of the period, and prorated warranty for the last 2 years.
3. Emergency fixtures Power Supply Batteries. 3 years beginning on the date of substantial completion. A full warranty shall apply for the first year of the period, and a prorated warranty for the last 2 years.

1.8 **SEQUENCING AND SCHEDULING**

A. **Coordinate with other work** including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of luminaires with other work.

B. **Sequence lighting installation** with other work to minimize possibility of damage and soiling during remainder of construction.

PART 2 - PRODUCTS

2.1 **GENERAL**.

A. Provide luminaires, of sizes, types, and ratings indicated on the Contract Documents complete with, but not limited to, housings, energy efficient lamps, lamp holders and wiring. Ship luminaires factory-assembled, with those components required for a complete installation. Luminaires have been selected based on quality, shape, texture, color, performance, lamps, and available accessories. Alternative luminaires may be considered by the Engineer/Architect when submitted by the Contractor and judged on the above criteria.

2.2 **WIRING**

A. **Provide electrical wiring** within luminaire as required for UL listing suitable for connecting to branch circuit wiring.

B. **Refer to Section 26 05 12**, "Wires, Cables, and Connectors," for wiring in conjunction with tandem-wired luminaires.

2.3 **LENSES, DIFFUSERS, AND REFRACTORS**

A. **Glass lenses shall be tempered** clear glass.

B. **Plastic lenses shall be 100 percent** virgin acrylic or polycarbonate as indicated. Prismatic lenses shall be injection molded with Type 12 pattern male prisms, 0.125 inch thick, except as otherwise specified on the Contract Documents. Lenses shall present a high resistance to yellowing and loss of strength due to aging, exposure to heat, and ultraviolet (UV) radiation.

C. **Metal louvers shall be aluminum** with specular, low iridescence, anodized finish, parabolic, except as otherwise specified on the Contract Documents.

D. **Glass refractors shall be borosilicate** glass with reflecting and refracting prisms, except as otherwise specified on the Contract Documents.

2.4 **LED LUMINAIRES**

A. **General**. Conform to UL 1570. NEC 2002 Article 240.83 instructs to use circuit breakers used to switch circuits must be listed and marked as "SWD."

B. **Energy Saving Magnetic Ballasts**. Provide energy saving fluorescent lamp ballasts, capable of operating lamp types indicated; with high power factor, rapid start, and low noise features; Type 1; Class P; sound rated A.

2.5 **LED LUMINAIRES**

A. **Provide** fixtures as specified in the lighting schedules.

2.6 **EXIT SIGNS**

A. **General**. Conform to UL 924.

B. **Sign Graphics**. Six inch red letters on a white background, with arrows as indicated on the Contract Documents.

C. **Lamps for ac Operation**. Light emitting diodes (LED), 70,000 hours minimum rated life.

2.7 **EMERGENCY EGRESS LUMINARIES**

A. **General**. Conform to UL 924.

1. Battery. As follows with special warranty.

   a. Lead calcium, maintenance-free, 5- to 8-year expected life.

2. Charger. Minimum 2 rate, fully automatic, solid-state type, with sealed transfer relay, test switch, and charge indicator light.
3. Operation. Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep discharge level. Relay disconnects lamps and battery. Battery automatically recharges and floats on trickle charger when normal voltage is restored.

4. Time Delay Relay. Provide time delay relay in emergency lighting unit control circuit arranged to hold unit ON for fixed interval after restoration of power after an outage.
5. Mounting Shelf. Where indicated, provide formed steel shelf for mounting emergency lighting units on walls or columns. Shelf shall be finished to match and blend in with the emergency lighting unit.

2.8 **LAMPS**

A. **General**. Lamps shall be provided for each luminaire which mate and match luminaire as recommended by the luminaire manufacturer. Unless otherwise

noted, provide lamps as specified below. Comply with ANSI C78 series that is applicable to each type of lamp.

B. **LED**.

2.9 **FINISHES**

A. **Manufacturer's standard, except as** otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters, and similar defects.

2.10 **LUMINAIRE SUPPORT COMPONENTS**.

A. **Comply with Section 26 05 29**, "Supporting Devices."

1. Single Stem Hangers. 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as luminaire.
2. Rod Hangers. 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
3. Chain Hanger. Chains with bridles secured to both corners of each end of luminaires and terminated at their upper ends as required to secure them to the building structure.

2.11 **EXTRA MATERIALS**

A. **Furnish extra materials described** below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Lamps. One lamp for every 10 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses. One for every 50 of each type and size installed. Furnish at least one of each type and size.
3. Globes and Guards. One for every 20 of each type and size installed. Furnish at least one of each type and size.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **General**. Examine areas and conditions under which luminaires are to be installed. Examine substrate/substrata for supporting luminaires. Notify the Engineer/Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with work until satisfactory conditions have been corrected in a manner acceptable to the Engineer/Architect.

B. **Install luminaires at locations** and heights as indicated, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, National Electrical Contractors Association (NECA) "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that luminaires fulfill requirements.

C. **Set units plumb, square, and level** with ceiling and walls, and secure according to manufacturer's written instructions and approved shop drawings. Support luminaires according to requirements of Section 26 05 29, "Supporting Devices."

D. **Install flush mounted luminaires properly** to eliminate light leakage between luminaire frame and finished surface.

E. **Install continuous row luminaires straight** and level for entire length including lenses, louvers, etc.

F. **Provide plaster frames for recessed luminaires** installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

G. **Install all luminaires** with Biax, PL or U florescent lamps such that all lamps in any given space run in the same direction.

1. Lamps in luminaires in long narrow spaces shall be installed parallel to the short dimension of the space.
2. Luminaires with PL or Biax lamps shall be installed such that the lamps are parallel with or perpendicular to the ceiling grid system or, in areas without grids, to the structure or room walls, except as otherwise directed by the Engineer/Architect.

H. **Supports**

1. Provide luminaires and/or luminaire outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by the Engineer/Architect.
2. Fasten luminaires securely to indicated structural supports. Ensure that pendant luminaires are plumb and level. Provide individually mounted pendant luminaires longer than 2 feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum 1 inch vertical adjustment. Mount continuous rows of luminaires with an additional stem hanger greater than number of luminaires in the row.
3. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box luminaires stud.
4. Recessed and Semirecessed Grid-Type Fluorescent Luminaires. Units shall not be supported from suspended ceiling support system. Install support system rods or wires at a minimum of 4 rods or wires for each luminaire, located not more than 6 inches from luminaire corners.
5. Luminaires Smaller than Ceiling Grid. Center in acoustical panel. Equip luminaire with bar hangers with integral slots for mounting directly to the ceiling grid. In addition, support all four corners of the ceiling grid from the structural ceiling with rods or wires.

3.2 CONNECTIONS

A. **Ground lighting units.**

B. **Tighten electrical connectors and terminals**, including grounding connections, according to manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. **Inspect each installed luminaire** for damage**.** Replace damaged luminaires and components.

1. Replace any inoperative lamps.
2. Replace any cracked or broken lenses.

B. **Give advance notice** of dates and times for field tests.

C. **Provide instruments to make** tests and record test results.

D. **Tests**

1. Verify normal operation of each luminaire after luminaires have been installed and circuits have been energized with normal power source. Perform a 100-hour continuous burn-in test of all luminaires to locate marginal components which will cause premature failure.
2. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation. Include the following information in tests of emergency lighting equipment.

    a. Duration of emergency supply.
    b. Low-battery-voltage shutdown.
    c. Normal transfer to battery source and retransfer to normal.
    d. Low-supply-voltage transfer.

3.4 **REPLACE OR REPAIR** malfunctioning luminaires and components with new luminaires and components then retest. Repeat procedure until all units operate properly. Units which fail two successive tests shall be evaluated by the Contractor for manufacturer's flaws and a report provided to the Engineer/Architect.

A. **Report results** of tests.

B. **Replace luminaires that show** evidence of corrosion during project warranty period.

3.5 **ADJUSTING AND CLEANING**

A. **Clean luminaires after installation.** Use methods and materials recommended by manufacturer. Clean luminaires, lamps, and lens/louver just prior to substantial completion. Replace failed or dimmed lamps and lamps with darkened ends.

B. **Adjust aimable luminaires** to provide an even light distribution over the area to be illuminated or as otherwise directed in the Contract Documents.

1. Provide personnel, tools, and equipment required to identify incorrectly aimed luminaires and to adjust any or all aimable luminaires to the satisfaction of the Engineer/Architect.

    a. In the event that amiable lighting is exterior, provide night illumination, identification, and adjustment for the length of time required to obtain lighting distribution and intensities satisfactory to the Engineer/Architect.

2. Set all stops and lock down all adjustments after aiming is approved by the Engineer/Architect.

END OF SECTION

SECTION 28 16 00

CLOSED CIRCUIT TELEVISION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Requirements of the following** Division 26 sections apply to this section:

1. "Basic Electrical Requirements."
2. "Basic Electrical Materials and Methods."
3. Fiber optic cables and patch panels provided by Electrical Contractor. All filed witing from patch panel to video sruvellance devices shall be by CCTV system supplier and installed in conformance with requirements of Division 26.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install intrusion detection systems in accordance with the plans and as specified herein.

B. **Extent of intrusion detection system work** is indicated by the drawings and these specifications and shall include intrusion detection systems and specified sensors, signal equipment, system controls, and alarm displays.

C. **Work Included:** Furnish and install a video surveillance system for the wellfield and Sugar Creek WTP. The surveillance system, designed for future expandability, shall consist of a bullet-type outdoor CCTV cameras, including ten (10) at the Well Buildings, one (1) at the front exterior lobby door, five (5) roof mounted units on the exterior of the buildings, and four (4) dome type PTZ CCTV wall mounted cameras on the interior of the Main Water Plant Buildings, and one additional spare cameras of each type. The camera, and four inside the Main Building building mounted cameras at for the following locations:

1. Installation of twenty-two (20) network-ready remote cameras with Pan-Tilt-Zoom capability, including installation of camera using brackets provided by housing manufacture to attach cameras to poles, building walls, or roof parapets. Provide 1 spare camera of each type as shown in schedule.
2. All cameras, mounting brackets and fasteners shall be components and housings shall be gasketed and designed to be airtight, constructed of 316 SS, FRP, or plastics. All mounting hardware and fasteners shall be 316 SS.
3. CCTV supplier to provide all CAT5 cabling to Electrical Subcontractor who shall provide furnish and install the conduit and vendor supplied cable. The CCTV system supplier shall coordinate the locations of cameras and the specific installation requirements. Location of the cameras shall be approved by the Owner/Engineer. The CCTV supplier under this Section, shall furnish and install the remote cameras, make all terminations to the

CCTV equipment, configure the CCTV equipment, test, and demonstrate that the system in fully operational.

D. **Video capture software** from collecting video input from 24 cameras, including 24 one-time camera licenses, video management software for configuration, monitoring data, and sharing data with third-party users across a VPN network connection video software, and system configuration shall be by Audio Video Supplier or System Integrator (Section 40 95 33) or factory trained technician with prior experience on minimum of 2 similar installations using video capture software and hardware being provided under this item.

E. **One (1) Rack-mounted computer server** Intel Core 3 CPU, 8 GB RAM, 30 TB HDD, 1 GB Ethernet connection. 2 – 1 GB NIC, DVD drives for installation of software, four (4) USB 2.0 ports, two USB 3.0 ports for video transfer, 2 – 32" 2 year service agreement for on-site maintenance and repair.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with Intrusion Detection Systems in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Comply with National Fire Protection Association (NFPA) 70, "National Electrical Code (NEC)."

2. Listing and Labeling. Provide system and components that are listed and labeled for their indicated use and location on the project.

   a. The terms "Listed" and "Labeled." As defined in the "NEC," Article 100. Comply with Underwriters' Laboratories, Inc. (UL) Standard 609, "Local Burglar Alarm Units and Systems."

3. Comply with UL Standard 1076, "Proprietary Burglar Alarm Units and Systems."

B. **Qualifications**

1. Manufacturer Qualifications. Firms experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance. The prime system manufacturer and manufacturers of major system components are required to qualify separately.
   a. Service Center. Prime system integrator or authorized factory service maintains a service center capable of providing training, parts, and emergency maintenance and repairs for the overall system at the project site with 48 hours maximum response time.
   b. Provide 24 hour/7-day week technical support via a call center resolve technical issues, address questions, or schedule emergency service call.

2. Installer Qualifications. Experience with systems of the type and scope indicated and authorized as a service representative of the prime system manufacturer.

3. Single-Source Responsibility. Obtain system components from a single source (the prime system manufacturer) that assumes responsibility for system components and for their compatibility.

1.4 SUBMITTALS

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

B. **Submit the following** in accordance with conditions of contract and Division 1 specification sections.

1. Product data for system components, including "Nationally Recognized Testing Laboratory" (NRTL) listing data and list of materials, dimensioned plans, sections, and elevations showing minimum clearances, mounting arrangements, and installed features and devices.
2. Wiring diagrams for system, including all devices, components, and auxiliary equipment. System diagram is unique to the project system; a manufacturer's generic system diagram is not acceptable. Diagrams differentiate between manufacturer installed and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.
3. System operation description, including method of operation and supervision of each component and each type of circuit, and sequence of operations for all manually and automatically initiated system inputs. Description must cover this specific project; manufacturer's standard descriptions for generic systems are not acceptable.
4. Operation and maintenance data for inclusion in "Operating and Maintenance Manual" specified in Division 1. Include data for each type product, including all features and operating sequences, both automatic and manual. Include user's software data and recommendations for spare parts to be stocked at the site. Provide names, addresses, and telephone numbers of service organizations that stock repair parts for the system.
5. Product certifications signed by the manufacturers of system components certifying that their products comply with the referenced standards.
6. Separate Qualification Data for Manufacturers and Installers. Demonstrate their capabilities and experience as specified in Quality Assurance Article. Include lists of completed projects with project names and addresses, names of Engineers and Owners, plus other information specified.
7. Record of field tests of system.

1.5 JOB CONDITIONS

A. **Environmental Conditions**. System withstands the following environmental conditions without mechanical or electrical damage or degradation of operating capability.

1. Altitude. Sea level to 1,000 feet (305 meters [m]).
2. Ambient Temperature for Interior Elements. 0 degrees Celsius (^{o} C.) to +25^{o} C.
3. Relative Humidity for Interior Elements. 5 to 50 percent, non-condensing.
4. Ambient Temperature for Exterior Elements. -25^{o} C. to +50^{o} C.

5. Relative Humidity for Exterior Elements. 0 to 100 percent.
6. Suitable for Outdoor Installation in Protected Enclosure

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

1.8 DEFINITIONS

A. **Hard Wired System**. Alarm, supervisory, and detection devices are directly connected, through individual dedicated conductors, to a central control panel.

B. **Multiplex System**. A communications link using a signaling method characterized by the simultaneous or sequential transmission, or both, and the reception of multiple signals in a communication channel, including means for positively identifying each signal.

C. **Zone**. Initiating device or combination of devices connected to a single intrusion detection device circuit for common display of alarms.

1.9 SYSTEM DESCRIPTION

A. **Description**. System uses a central microprocessor, remote intrusion sensors and detection devices, and a communications link to perform monitoring and alarm functions. System is physically and electronically modular and has provision for field expansion. System is self-monitoring and self-diagnostic.

B. **Communication Link**. Hard wired, using separate individual circuits for each zone of alarm initiation and alarm device operation.

1.10 FUNCTIONAL PERFORMANCE

A. **Intrusion Detection**. Performed by indicated intrusion detection devices. Devices are assigned to detection zones as indicated.

B. **Alarm Indication**. Audible signal sounds and a plain language identification of the zone originating an alarm appears on a LED or liquid crystal display at the alarm control panel. Control system includes one or more remote addressable microprocessor control units operating in a multiplexed distributed control system or as part of a network under the control of a central microcomputer. Control units receive programming by multiplexed signal transmission from a central microprocessor or microcomputer and hold data in nonvolatile memory. System reboots program automatically without error or loss of status or alarm data after a power outage. An alarm light is displayed at the WTP Security Control Center.

C. **Permissible Signal Time Elapse**. The maximum permissible elapsed time between the actuation of any alarm or detection and its indication at the alarm control panel is 2 seconds.

D. **Independent System Monitoring**. Supervise each intrusion detection device for both normal operation and trouble.

E. **Circuit Supervision**. Indicate circuit faults with both zone and trouble signals at the alarm control panel. Provide a distinctive audible tone and LED indicating light. The maximum elapsed time between the occurrence of a trouble condition and indication at the control panel is 20 seconds.

F. **Secure Access Control**. System may be programmed to change the status of various combinations of zones automatically from "secure" to "access" at any scheduled times. Schedules for status changes may be preset for repetitive daily and weekly operation and for special scheduled operation up to a year in advance.

G. **Manual status control** by secure access control station overrides programmed settings.

PART 2 - PRODUCTS

2.1 INTRUSION DETECTION SYSTEM EQUIPMENT, GENERAL

A. **Surge Protection**. Comply with minimum requirements of UL Standard 1449, "Transient Voltage Surge Suppressors," for each component using solid state devices and having a line voltage power source connection or an exterior underground signal connection.

B. **Interference Resistance**. Systems and equipment and their operation are not affected by radiated radio frequency interference and electrical induction of 15 V/m over a frequency range of 10 to 10,000 millihertz (MHz). MHz and conducted interference signals up to 0.25 V RMS injected into power supply lines at 10 to 10,000 MHz.

C. **Tamper Protection**. Equip detection devices; control, annunciator, and data gathering panels; and other system components indicated with tamper switches. Arrange tamper switches to provide an alarm signal when the unit is opened or partially disassembled.

2.2 ELECTRICAL POWER

A. **Normal System Power Supply**. 120 V 60 hertz (Hz) from locked disconnect device. System components are supplied with power through the system control panel.

B **Power Source Transfer**. When normal power is interrupted, system is automatically switched to backup supply without degradation of critical system function or loss of signals or status data.

1. Backup Source. Automatic starting diesel engine generator set, through an automatic transfer switch conforming to Division 26 Section "Transfer Switches."
2. Backup Source. A dedicated circuit from an uninterruptible power supply system.

3. Annunciation. Switching of the system or any system component to backup power is indicated on the system control panel as a change in system condition.

2.3 INTRUSION DETECTION DEVICES, GENERAL

A. **Types, features, accessories**, and mounting conditions of individual devices are as indicated.

B. **Alarm Contact Arrangement**. Contact making intrusion detection devices are single pole, double throw type.

2.4 DOOR SWITCHES

A. **Not Used**

2.5 SPACE INTRUSION DETECTION DEVICES

A. **Comply with UL Standard 639**, "Intrusion Detection Units," and the following general requirements:

1. Configuration. Devices consist of a single component or two or more separately mounted components as indicated or as required to perform functions. Single component devices may not be used where multiple component devices are indicated.
2. Power Source Characteristics. Devices are supplied by one or more dedicated 120 V 60 Hz supply circuits from the alarm control panel.
3. Detection Indicator. LED in unit housing, latching type where indicated.
4. Sensitivity. Units detect presence of an intruder within their specified detection patterns and are insensitive to influences outside the pattern.

B. **Passive Infrared (PIR) Devices**. Detect intrusion by monitoring infrared energy emitted within the protected zone. Units are sensitive to the infrared wavelengths emitted by the human body and are insensitive to general area thermal variations.

1. Wall-Mounted Units. Maximum detection range for individual units exceeds scheduled distance by 25 percent, but is not less than 50 feet (15 m).
2. Ceiling-Mounted Units. Full 360-degree conical spot detection pattern. With device mounted at 8 feet (2,500 millimeters [mm]) above the floor the pattern at floor level is a minimum diameter of 7 feet (2,000 mm). With device mounted at 25 feet (7,600 mm) above the floor the pattern at floor level is a minimum diameter of 18 feet (5,500 mm).

C. **Microwave Devices**. Use a microwave transmitter to establish an electromagnetic field in the detection pattern and to detect intrusion by monitoring changes in the pattern.

D. **Acoustical Devices**. Detect intrusion by monitoring the pattern of a steady state sonic field produced by an ultrasonic transmitter. Changes in the pattern are analyzed and those matching the profile of an intrusion initiate an intrusion alarm.

E. **Glass Break Devices, Acoustic Type**. Detect the unique airborne acoustic energy spectrum caused by breaking glass.

F. **Vibration Devices**. Detect intrusion by using piezoelectric sensors or electric cable to sense vibration, movement, or presence change. Devices process signals from the detecting elements to distinguish those caused by natural influences from those caused by intrusion.

G. **Dual Technology Devices, Passive Infrared and Microwave**. Combine the two detection methods described above in a single housing.

1. Detection by both methods results in an alarm signal.
2. Detection by either or both methods results in an alarm signal. A control in the device selects the operating mode.

H. **Dual Technology Devices, Passive Infrared and Acoustical**

1. Detection by both methods results in an alarm signal.

I. **Dual Technology Devices, Glass Break and Vibration**

1. Detection by both methods results in an alarm signal.

J. **Infrared Beam Devices**. Photoelectric type, using an infrared emitting diode in a pulsed mode. Each device consists of separate transmitter and receiver units, one mounted at each end of the beam path. Where indicated, units are dual beam type. Features include the following:

1. Response Time. Adjustable.

2.6 CLOSE CIRCUIT TELEVISION SURVEILLANCE SYSTEM

A. Equipment.

1.. Description of Work: The Contractor, shall provide all labor, materials, and tools to furnish and install all video surveillance equipment, computer hardware and software, and configuration services, to provide a complete and functional video surveillance system, including installation of twenty-two (22) video cameras at the locations shown on the plans,

a. The Contractor shall provide all power, control and data communication wiring and raceways to connect remote cameras to central video-recording and monitoring computer system to be installed at the SCADA Control Room. Equipment furnished and installed under this item includes mounting poles, support brackets, network-ready cameras, mounting brackets, outdoor dome enclosure, and connections to power, intrusion detection devices, and fiber communication network.

b. The Contractor shall include the services of the CCTV Supplier of the SCADA System Integrator or factory trained specialists to

configure the computer hardware and software, and providing three (3) days of start-up, testing, and training. All equipment shall be covered by a 2-year maintenance warranty, and all software shall include 1 year of software support after final acceptance of the system.

2. Equipment Schedule

The following equipment, computer hardware, computer operating systems software, data storage devices, video security software licenses, factory technical support and training shall be provided as follows:

a. IP Cameras

Item **Quantity** Description -	**Features**
4 - 4 MP dome type PTZ Indoor/Outdoor Cameras 1- spare Indoor/Outdoor dome camera	Dome Indoor/Outdoor PTZ Camera 1. Megapixel 8MP (4K) high definition resolution 2. Auto/Manual zoom 3. Low Light 0.1 LUX Color 4. 2592*1520 resolution 5. 30 frames per seconds @ all resolutions 6. 4X Optical zoom 7. Pan 355 degree. Tilt 90-degree down 15 degree up.
16 - 5MP outdoor bullet type PTZ cameras 1 - spare outdoor bullet PTZ camera	Bullet Type Outdoor PTZ Cameras 1. Megapixel 8MP (4K) high definition resolution 2. Auto/Manual zoom 3. Low Light 0.1 LUX Color 4. 2592*1920 resolution 5. 30 frames per seconds @ all resolutions 6. 4X Optical zoom Pan 355 degree. Tilt 90-degree down 15-degree up. Tilt/Zoom camera: Supports remote rotation control, Pan 355 degree. Tilt 15 degree (90-degree min), min 20X optical and 12 digital zoom by megapixel vari-focal lens, Viewing Distance is 10-300 feet
	3. External GB SD card slot, Support Max 128GB Micro SD card.

	4. Embedded infrared LEDs for night vision range up to 50 meters (165 feet)
	5. Motion detection alert notification via App or Email and recording image and video to SD Card or Multiple Storage Options such as NVR, FTP Server, computer disk.
	6. Wireless WIFI or wired cable connection to the internet and capable of image/live video on smart phone
	7. Support two-way audio (Built-in MIC and speaker)
	8. Video Compression: H.264 main profile, support dual stream, H.265, H.264, MJPEG codec supported, multiple streaming AVI format. Support RTSP Compatible with AVI Media Player
	9. Wireless: IEEE 802.11 b/g/n
	10. Power: DC 12V 2A
	11. Operating Environment: -20℃~+60 ℃ (-4℉~+140℉), Humidity 10%～90%, non-condensing
Manufacturers	
1. Tyco Security Products IPS08-P25-RT0 Illusta 8 MP IPS08-P25-RT0 Smart Network Camera	
2. Hanwha Techwin America Wisenet 5 HD Network IR camera,	
3. Approved Equal	

b. Hybrid servers and IP camera network video recorder (NVR)

Functionality	**Minimum Requirements**
iP Model or Equal	
Maximum IP Cameras	32
Included iP Licenses	24
Server	A-Series IPS 2UA
Pre-Loaded VMS Software	Professional
Typical Video Storage Rate (Mbps)	300 Mbps (Windows)
Local Client Display Rate (Frames Per Second (FPS)	Windows - 700 @ HD resolution
Maximum Hard Drives	3
Maximum Storage	30 TB
Monitor Output	1 DVI-I + 1 HDMI + 1 Display Port + 1 VGA
	max 2 simultaneous monitors
Operating System	Windows 10
	Windows Server 2016
Operating System Drive	120 GB SSD
Operating System Redundancy	RAID 1 (Provide Space for Future)
CPU	Intel® Core i5l)
RAM	16 GB
NIC	2
USB	4x USB 2.0, 2x USB 3.0
DVD	Internal
Audio Outputs	1
Keyboard & Mouse	Wireless
Manufacturer	TYCO exacqVision A-Series IPS 2U or equal

c. Video Control Center Software

Functionality	**Minimum Requirements**
Camera Licenses - Provided under this Contract	24 –pack camera license
Camera Licenses - Future Expandability	Minimum of 32 licenses
Technical Support and Software Supplier after final acceptance	2 year
Ethernet I/O modules	2
Manufacturer On-site Start-up Assistance and Training	3 days

B. Functional Description

1. The system shall support multiple types of communication infrastructures including internet, IP radios, leased lines, data radios, satellite, cellular, etc.; and, shall have the ability to work with any combination of these as part of the overall communication infrastructure.

2. The system shall support a set of distributed components (hardware and software) that allow for DVR recording "at the edge" along with event based alarming and automatic event based clip generation and notification. The system shall support for the deployment of four types of system components to meet the diverse nature of a highly distributed security system.

Application	Infrastructure	Key Unique Requirements
Remote Assets	IP Radios, Cellular, Satellite, Frame Relay. Shared PLC/RTU protocols	1 or 2 Cameras Low Power = 9 Watts High Temp = -40 to 70(Deg C) 3 days built-in non-moving DVR storage (expandable) Event based alarm clip generation and operator notification Shared PLC/RTU protocols IPSec Security support SCADA Integration Access Control
Remote Facilities	IP Radios, Cellular, Satellite, Frame Relay. Shared PLC/RTU protocols	Up to 6 IP Cameras 30 Days DVR storage (expandable) Event based alarm clip generation and operator notification Shared PLC/RTU protocols IPSec Security support SCADA Integration Access Control
Central Plants	LAN IP connection	Software DVR (runs on PC) Up to 16 Cameras 1280 by 1024 Resolution 30 frames per second Event based alarm clip generation and operator notification IPSec Security support SCADA Integration Access Control
Central Management Software	PC based Software. Supports multiple and diverse communication protocols for different remote types (see above)	Central Administration with remote configuration support. Centralized Event/Alarm database. Web based access to runtime and administration. Integrated Windows user security

3. The system should be able to easily switch to support wireless IP connections such as cellular or internet IP satellite connections.
4. The video system shall consist of a distributed architecture of event based video surveillance components along with a centralized configuration and event management system. Video monitoring shall consist of a combination of remote video engines as well as one or more local plant video engines aggregated into a single comprehensive system for monitoring and viewing.

5. Each system shall support at least the following modes of video collection and transmission.
6. Live Streaming – of one or more selected remote cameras.
7. Guard Tour – ability to periodically sample and store all cameras in the system.
8. Video Event Clips – generates video clip based on event, capturing video before and after the event or for the duration of the event trigger.
9. Local DVR archival of at least 30 days or 3 to 5 days for the Micro Video Engine.
10. Each system shall support the ability to monitor for external events with up to 12 input sensors, to use direct built-in video motion analysis, or to utilize available events existing on supported cameras. When an event is detected, the system shall generate an event clip using configurable "before" and "after" times or "while active" time. The clip shall support up to 640 by 480 resolution and frame rates of up to 5 frames per second.
11. This event clip shall be automatically transmitted to a central system for storage, playback, and automatic user notification via email or phone. The system shall support "Store/Forward" capability; storing up to 32 event clips on the video engine in the event of communication loss as well as allowing for the connection to be lost during transfer of an event clip and have the download continue automatically and without operator interaction after the communication has been reestablished with no loss in video frames or quality.
12. The system shall provide centralized web-based configuration of all video collection devices with the ability to remotely download or upload new configuration parameters over the above listed communication infrastructures or PLC data systems.
13. The system shall provide a web-based interface for viewing of live feed video, event clip playback, DVR playback over TCP/IP networks and event historian access as well as full system configuration and deployment.
14. The system shall support live video viewing, event clip playback, and DVR video playback as well as full system configuration abilities through Microsoft Internet Explorer web browser ActiveX controls inserted into supporting applications for seamless integration.
15. The system shall provide open access and integration of video live feed, event clip playback, DVR video playback and event historian access directly within a SCADA system's operator graphics page.
16. The system shall support an OPC Data Access server that would allow the integration of real-time status and security alarm information of all video capture devices into the HMI's alarming system. Furthermore, operator output actions such as goto preset, arm/disarm, and providing remote authorized entry shall be available by the HMI should this interface be utilized.
17. The system shall support a Modbus TCP server that would allow the integration of real-time status and security alarm information in the form of Modbus registers, of all remote video capture devices. Furthermore, operator output actions such as goto preset, arm/disarm, and providing remote authorized entry shall be available by the HMI should this interface be utilized.
18. The system shall support integration with third party access control systems and external user security panels to provide arming and disarming through hard wired inputs into the system via the provided I/O module, Modbus TCP Ethernet I/O devices or supported camera I/O. Inputs into

the system shall have the ability to trigger an alarm and associated video clip as well as arming and disarming of individual alarm zones or the entire system.

19. The system shall have the ability to automatically trigger up to 4 outputs when an input is triggered to unlock doors/gates, turn on lighting, notify third party products, arm/disarm the system, etc….
20. The system shall support medium speed (19.2K to 512K bits/sec) IP based radio connections using TCP or UDP with sufficient error handling and bandwidth management to allow for up to 100 remote cameras. The system shall also support low speed (2400 Baud to 9600 Baud) Serial based radio connections using licensed or unlicensed frequencies or telephone dial out modems with sufficient error handling and bandwidth management.
21. The system shall support up to 9 serial HID based badge card readers supporting HID formatted access cards. Valid card access can trigger an output at the reader to unlock a door and additionally disarm an associated zone or the entire system.
22. The system shall support one numeric keypad that can be placed in or outside of the facility. The system shall support system and per user passwords that will arm or disarm individual alarm zones or the entire system.
23. The system shall support a two pass security verification mode where access to the facility would only be allowed if both a valid badge and badge specific password are entered.
24. The readers shall be able to trigger an alarm and associated video clip if a Bad Badge, Tamper Event, or Unauthorized Door Open event is detected.
25. The system shall support a centralized configuration and permissions control of all users and permissions. The system shall support automatic deployment of permissions and rights from the central system to all of the remotes and associated readers using the available communication channels outlined above.
26. The system shall support the granting of individual door/reader access permission as well as per user passwords with optional password expiration. The system shall support the on-line redeploy of permissions from the central system.
27. Readers and keypads are required to work in stand-alone mode as well as network mode. In the event that network communications is lost, the reader or keypad shall switch to stand-alone mode and perform local badge validation and door control.
28. The system shall support the remote monitoring and door operation remotely via a web page, as well as, integrated into an HMI using OPC Data Access or Modbus TCP servers.
29. The system shall support integrated PTZ operations via a PTZ enabled IP camera.
30. The system shall support up to 6 named PTZ presets per camera. Any event (sensor, video analytic, camera event, reader event, keypad event) can be configured to automatically move one or more cameras to a specific preset to generate a video clip.
31. All PTZ camera operations shall allow remote and local control including (pan, tilt, zoom increments and goto preset operations). This operator control shall be supported through a web page, ActiveX control, or via OPC Data access or Modbus TCP servers.

32. The system shall support the integration of up to 6 IP cameras at each remote site and 24 at the central main plant site. The system will perform all local storage, event detection, queuing, and live feed management of an IP camera in the same way it handles one of the 4 analog video inputs. That is, systems that will use IP cameras DO NOT require an IP connection between the Video Engine and the central station.
33. The system shall support any combination of analog or IP cameras up to a maximum of 12 total cameras per Video Engine.
34. The system shall allow for IP camera events (DI, Motion, Audio, Tamper, or No Video signal) to generate a system alarm and trigger an event video clip.
35. The system shall support the ability to prevent access to the web-based configuration by using Windows Integrated system security. That is, standard Windows domain or system user accounts shall be granted permission to configure the system. Any user without authorization will not be granted access to view or make changes to the system.
36. The system shall support optional 128 bit TCP Encryption between the central station and all remotes.
37. The system shall support the ability to publish an MJPEG video stream of any of the remote Video Engine's cameras to allow video integration into third-party in-plant security products.
    a. Security The system shall support the ability to prevent access to the web-based configuration by using Windows Integrated system security.
    b. The system shall support the use of standard Windows domain or system user accounts as authentication and be able to granted permission to configure and /or monitor the system events and video.
    c. The system shall support optional 128-bit TCP Encryption between the central station and all remotes. Furthermore, the system shall also enforce support data encryption between the central station and all LAN clients (video streaming and OPC access). Streaming

C. **Comply with UL Standard 1023**, "Household Burglar Alarm System Units."

D. **Comply with UL Standard 1076**, "Proprietary Burglar Alarm Units and Systems."

E. **Cabinet**. Lockable steel enclosure. Arrange panel so all operations required for testing or for normal operation and maintenance are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of panels as well as field wiring. Identify each enclosure by an engraved, laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1 inch (25 mm) high. Identify individual components and modules within the cabinets with permanent labels.

F. **Systems**. Alarm and supervisory systems are separate and independent in the control panel. The alarm initiating zone boards in the panel consist of plug-in cards. Arrangement requiring removal of field wiring for module replacement is not acceptable.

G. **Control Modules**. Types and capacities as required to perform all functions of the system. Visible and audible signals in the control panel indicate alarm, supervisory, and trouble conditions for each zone. Each type of audible alarm has a distinct sound.

H. **Zones**. The quantity of alarm and supervisory zones as indicated with capacity for expanding the number of zones by a minimum of 25 percent.

I. **Power Supply Circuits**. Panel provides power for remote power consuming detection devices. Provide adequate circuit capacity for at least a 25 percent increase in load.

J. **Indicating Lights**. Individual LED devices designate each zone. An LED test switch for each control panel section illuminates all LED devices on that section of the control panel. Manual toggle test switches or push test buttons do not require a key to operate. Alarm and supervisory signals light a red LED for the associated zone. Trouble signals light an amber LED for the associated zone.

K. **Resetting**. Controls permit silencing audible signals for individual zones but prevent the resetting of alarm, supervisory, or trouble signals while the condition still exists.

2.7 SECURE ACCESS CONTROL STATIONS

A. **Keypad and display module** is arranged for entering and executing commands for system status changes and for displaying system status and command related data.

B. **Key operated switch changes system** between "secure" and "access" modes.

2.8 WIRE AND CABLE

A. **General**. Stranded copper. Size conductors as indicated but not less than recommended by system manufacturer.

B. **Comply with Division 26 section** "Wires and Cables" except as indicated.

C. **Cable for Low-Voltage Control and Signal Circuits**. Unshielded, twisted pair cable, except where manufacturer recommends shielded cable. Comply with Division 26 Section "Control/Signal Transmission Media."

2.9 RACEWAY

A. **Comply with Division 26** section "Raceways."

2.10 MISCELLANEOUS HARDWARE

A. **General**. System includes supports, mounting brackets, and installation hardware for components. Metal hardware is of corrosion resistant material.

2.11 **EXTRA MATERIALS**

A. **General**. Furnish extra materials described below that match products installed, packaged with protective covering for storage and identified with labels clearly describing contents.

B. **Intrusion Detection Devices**. Furnish quantity equal to 5 percent of the number of units of each type installed but not less than one of each type.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **General**. Install system according to NFPA 70, applicable codes, and manufacturer's printed instructions.

1. Location and direction of video surveillance cameras shall be determined in the field by the Owner and Engineer
2.. Demonstrate the ability of the Video Surveillance System, i.e. cameras, camera server, console monitor, and video recorder, to operate under normal operating conditions.
3. Provide on-site training for City personnel.
4. Replace all equipment found defective at no expense to the Owner.

B. **Comply with UL Standard 681**, "Installation and Classification of Mercantile and Bank Burglar Alarm Systems."

C. **Wiring Method**. Install wiring in raceways. Conceal raceways except in unfinished indoor spaces.

D. **Wiring Within Enclosures**. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.

E. **Number of Conductors**. As recommended by system manufacturer for functions indicated.

F. **Splices, Taps, and Terminations**. Make splices, taps, and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.

G. **Tighten connections** to comply with tightening torques specified in UL Standard 486A.

H. **Identification of Conductors and Cables**. Color code conductors and apply wire and cable marking tape to designate wires and cables so media are identified and coordinated with system wiring diagrams.

I. **Install power supplies** and other auxiliary components for detection devices at the alarm control panel or at a data gathering panel except as otherwise indicated. Do not install such items in the vicinity of the devices they serve. Provide tamper switches where mounted separately from control panels.

J.

3.2 GROUNDING

A. **Ground system components** and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

3.3 FIELD QUALITY CONTROL

A. **Manufacturer's Field Services**. Provide services of a factory authorized service representative to supervise the field assembly and connection of components and system pretesting, testing, adjustment, and programming.

B. **Inspection**. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

C. **Pretesting**. Align and adjust the system and perform pretesting of all components, wiring, and functions to verify conformance with specified requirements. Correct deficiencies by replacing malfunctioning or damaged items with new items. Retest until satisfactory performance and conditions are achieved.

D. **Testing**. Provide at least 10 days' notice of acceptance test performance schedule.

E. **Operational Tests**. Perform operational system tests to verify conformance with specifications. Test all modes of system operation and intrusion detection. Methodically test for false alarms in each zone of space intrusion detection devices by simulating activities outside indicated detection patterns.

F. **Retesting**. Correct deficiencies and retest until the total system meets the requirements of the Specifications and complies with applicable standards.

G. **Prepare test** and inspection reports.

3.4 ADJUSTMENT

A. **Occupancy Adjustments**. When requested within 1 year of date of substantial completion, provide on-site assistance in adjusting and reprogramming to suit actual occupied conditions. Provide up to two visits to the site for this purpose without additional cost.

3.5 TRAINING AND DEMONSTRATION

A. **Train Owner's operating personnel** in the programming and operation of the system. All connectors, mounting equipment, cables, routers antennas, switches and all other hardware and labor required for a complete and fully functional installation Train Owner's maintenance personnel in the procedures and schedules involved in preventive maintenance and in programming, operating, adjusting, troubleshooting, and servicing of the system.

B. **Schedule training** with advance notice of at least 7 days.

C. **Training Requirements:** Provide one (1) 4-hours on-site training session for City personnel. Provide two (2) - 4 hour training sessions to plant personnel on the operation, storage, retrieval, and sharing of data obtained using the of CCTV software.

3.6 WARRANTY

A. **Provide two years** of 24/7 technical support using emergency call in number with 4-hour return call by technical support representative, and if required, schedule on-site service by field technician no later than 48-hours of initial call for on-site repairs during the 2- year warranty period.

B. ` **Labor two-year warrantee** on the video surveillance system hardware and software, including beginning on the date of Substantial Completion.

END OF SECITON

SECTION 31 05 19

GEOTEXTILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide all labor, materials, tools, supervision, transportation, and equipment necessary to install the geotextiles as shown on the plans and as specified herein. This includes the following:

1. Installation of geotextile layer over leachate collection system (LCS) aggregate as a filtration layer.
2. Installation of geotextile above geomembrane as a cushion layer.
3. Installation of geotextile under rock channel protection.
4. Protecting geotextile from uplift due to wind before, during, and after installation.
5. Installation of geotextile in conjunction with the earthwork and other components of the liner system.
6. Installation of geotextile as a separation layer between dissimilar materials.

1.3 QUALITY ASSURANCE

A. **Codes**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the standards listed below in "References" as directed and amended by this section.

C. **The installation of geotextiles** shall be monitored as specified in this section and as outlined in the Construction Quality Assurance (CQA) Plan.

D. **Be aware of the activities** outlined in the CQA Plan and shall account for these CQA activities in the installation schedule.

E. **References**

1. CQA Plan.

2. Latest version of American Society for Testing and Materials (ASTM) standards:

a. ASTM D 3786, "Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabric -Diaphragm Bursting Strength Tester Method."
b. ASTM D 4355, "Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)."
c. ASTM D 4491, "Standard Test Method for Water Permeability of Geotextiles by the Permittivity Method."
d. ASTM D 4533, "Standard Test Method for Trapezoid Tearing Strength of Geotextiles."
e. ASTM D 4632, "Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)."
f. ASTM D 4751, "Standard Test Method for Determining Apparent Opening Size of a Geotextile."
g. ASTM D 4833, "Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products."
h. D4873, “Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
i. ASTM D 5261, "Standard Test Method for Measuring Mass Per Unit Area of Geotextiles."

3. Daniel, D.E. and R.M. Koerner, (1993), *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93/182.

4. Ohio Department of Transportation (ODOT), *State of Ohio Department of Transportation Construction and Material Specifications*.

1.4 SUBMITTALS

A. **Submit to the Quality Assurance** (QA) Manager the following information on geotextile production:

1. Manufacturing quality control certificates for each shift's production. The certificates shall be signed by responsible parties employed by the manufacturer (such as the production manager) and notarized.

2. The quality control certificate shall include:

a. Lot, batch, or roll numbers and identification.
b. Sampling procedures.
c. Results of quality control tests, including a description of the test methods used.

B. Shop Drawings:

1. Manufacturer’s documentation that raw materials and roll materials comply with required geotextile physical properties.
2. Manufacturer and Installer quality control manuals.
3. Original test results for resins, roll material and factory seam tests at frequency specified in repsctive quality control manuals.

4. Geotextile layout plan with proposed size, number, position and sequencing of geotextile rolls and direction of all field seams.
5. Proposed details of anchoring and overlapping if different than included in Contract Documents.

C. Information Submittals:

1. For needle punched geotextiles, the manufacturer shall certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers.

2.Qualification documents specified in Contract Documents.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Transport the geotextiles. Be liable for all damages to the materials incurred prior to and during transportation to the site.

B. **Storage and Handling**

1. Label, handle, and store geotextiles in accordance with ASTM D4873 and as specified herein.
2. Handle, store, and care of the geotextiles prior to and following installation at the site. Be liable for all damages to the materials incurred prior to final acceptance of the lining system by the QA Manager.
3. Be responsible for storage of the geotextile material at the site.
4. Protect the geotextiles from sunlight, moisture, excessive heat or cold, puncture, or other damaging or deleterious conditions. Protect the geotextile from mud, dirt and dust. Be responsible for any additional storage procedures required by the manufacturer.
5. Handle the geotextile with care.
6. Use adequately sized equipment to handle geotextile in order not to risk damage. Do not damage the geotextile due to handling, trafficking, excessive heat, leakage of hydrocarbons, or other means.
7. All personnel handling geotextile shall not smoke, wear damaging shoes, or engage in other activities which could damage the geotextile.

1.7 SPECIAL WARRANTY

Not used.

1.8 RESPONSIBILITY

A. **Contractor**. Provide the services of a geotextile manufacturer, and installer, who shall meet the following qualifications. Accept and retain full responsibility for all materials and installation and be held responsible for any defects in the completed system.

B. **Manufacturer**

1. The geotextile manufacturer shall be responsible for the production and delivery of geotextile rolls and shall be a well-established firm with more than 2 years' experience in the manufacture of geotextiles. The manufacturer shall submit a statement to the QA Manager listing:

    a. Certified minimum property values of the proposed geotextiles and the tests used to determine those properties.
    b. Production capacity available and projected delivery dates for this project.

C. **Installer**

1. The installer shall be responsible for field handling, storing, deploying, seaming or connecting, temporary restraining (against wind), anchoring, and other site aspects of the geotextiles.
2. The installer shall be trained and qualified to install geotextiles. The installer's qualifications will require the QA Manager's approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **Geotextile Properties**

1. Geotextile shall be nonwoven, needle-punched polypropylene or polyester fabric.
2. All manufacturers must be approved by the QA Manager.
3. Unless otherwise noted on the drawings, geotextile suppliers shall furnish materials whose minimum average roll values meet or exceed the criteria specified in Table -1 and Table -2. The manufacturer shall provide test results for these procedures, as well as a certification that the material properties meet or exceed the specified values. The geotextiles provided by the supplier shall be stock products. The supplier shall not furnish products specifically manufactured to meet the specifications of this project unless authorized by the QA Manager.
4. Minimum average roll value (MARV) shall be based on manufacturer's data and shall be calculated as the mean value of the property of interest plus or minus two standard deviations, as appropriate. Where material properties vary among the machine and cross-machine directions, the MARV shall apply to the direction providing the lowest value (when a minimum is specified) or the highest value (when a maximum value is specified).
5. In addition to the property values listed in Table -1 and Table -2, the geotextiles shall retain their structure during handling, placement, and long-term service.
6. The Contractor shall supply documentation demonstrating the in-ground durability of the proposed geotextile. This documentation shall be submitted to the QA Manager prior to the start of construction, unless otherwise approved by the QA Manager. Approval of the geotextile products based on the documentation is at the discretion of the QA Manager.

7. The QA Manager shall approve all construction materials before use. Approval shall be based on conformance to the construction plans and these specifications.

2.2 MANUFACTURING QUALITY CONTROL

A. **Sampling**. The Manufacturer shall sample and test the geotextile material, at minimum frequencies specified in Table -3 to demonstrate that the material conforms to the requirements in Part 2.1 of this Section. As a minimum, comply with the submittal requirement of Part 1.4 of this section.

B. **Repair**. Perform sampling, in general, on sacrificial portions of the material such that repair of the material is not required.

C. **Rejection**. Samples that do not meet the specified properties shall result in rejection of the applicable rolls.

D. **Additional Testing**. At the Manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify the noncomplying rolls and/or to qualify individual rolls.

2.3 MANUFACTURING QUALITY ASSURANCE

A. **Conformance Testing**. Conformance testing shall defined as independent manufacturing quality assurance testing. The need for conformance testing shall be determined by the QA Manager.

B. **Sampling**

1. Upon delivery to the site or at the location of the manufacturer, samples of the geotextile shall be removed by the QA Manager or his designee and sent to a laboratory for testing to ensure conformance to the requirements of this Section.
2. Samples shall be selected by the QA Manager in accordance with this Section and the procedure outlined in the CQA Plan.
3. Samples shall be taken at the rate of one sample per lot or one per 100,000 square feet, whichever is less.
4. The QA Manager may increase the frequency of sampling as outlined in the CQA Plan in the event that test results do not comply with requirements specified in Part 2.1 of this Section. This additional testing shall be performed at the expense of the Contractor.

C. **Rejection**. Any geotextiles that are not certified in accordance with Part 1.4 of this section, or that conformance testing indicates do not comply with Part 2.1 of this section shall be rejected and replaced with new material in accordance with the specifications, at no additional cost to the Owner.

2.4 PACKING AND LABELING

A. **Wrapping**. Geotextiles shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.

B. **Marking**. Geotextile rolls shall be marked or tagged with the following information:

1. Manufacturer's name.
2. Product identification.
3. Lot or batch number.
4. Roll number.
5. Roll dimensions.

C. **Special Handling**. If any special handling is required, it shall be so marked on the geotextile itself; e.g., "This Side Up" or "This Side Against Soil to Be Retained."

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Familiarization**. Prior to implementing any of the work described in this section, become thoroughly familiar with all portions of the work within this section or related sections, as necessary for successful completion of the work.

B. **Inspection by Contractor**

1. Prior to implementing any of the work in this Section, carefully inspect the installed work of all other sections and verify that all work is complete to the point where the installation of this section and the CQA Plan may properly commence without adverse impact.
2. If there are any concerns regarding the installed work of other sections, notify the Owner in writing within 48-hours of site inspection. Failure to inform the Owner in writing or installation of the geotextile will be construed as Contractor's acceptance of the related work of all other sections.

3.2 INSTALLATION

A. **Handling**. Handle all geotextile in such a manner as to ensure that they are not damaged in any way.

B. **Damage to Underlying Layers**. Take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.

C. **Untraviolet Light**. After unwrapping the geotextile from its opaque cover, do not leave the geotextile exposed for a period in excess of 20 days unless a longer exposure period is approved by the QA Manager, based on a formal demonstration that the geotextile is stabilized against ultraviolet (UV) degradation for the proposed period of exposure.

D. **Snowblindness**. If white colored geotextile is used, take precautions against "snowblindness" of personnel.

E. **Damage**. Take care not to entrap stones, excessive dust, or moisture in the geotextile during placement.

F. **Wind Damage**. Weight all geotextiles with sandbags, or the equivalent, in the presence of wind. Install such sandbags during placement and leave them until they are replaced with protective soil cover or other components of the liner system.

G. **Foreign Objects**. Examine the entire geotextile surface after installation to ensure that no potentially harmful foreign objects are present. Remove any such foreign objects and replace any damaged geotextile.

3.3 SEAMS AND OVERLAPS

A. **Seaming**. All nonwoven geotextiles shall be continuously sewn (i.e., spot sewing is not allowed). Geotextiles shall be overlapped a minimum of 6 inches prior to seaming. No horizontal seams shall be allowed on slopes steeper than 5 horizontal to 1 vertical (i.e., seams shall be along, not across, the slopes). Other seaming techniques may be approved by the QA Manager.

B. **Thread**. Polymeric thread, with chemical resistance properties equal to or exceeding those of the nonwoven geotextile, shall be used for all sewing. The seams shall be sewn to provide a flat (prayer) seam, "J" seam, or "butterfly-folded" seam and shall be a two-thread, double-lock stitch or a double row of single-thread, chain stitch.

C. **Stitching**. When sewing a flat seam, the stitching shall be approximately 1-1/2 inches (1/4 inch) from the outside edge of the fabric (not in the selvage or at the selvage edge). The "J" fold and butterfly fold seams require a fold 1-1/4 inches to 2 inches from the fabric edge with the stitching approximately 1 inch from the folded edge.

D. **Foreign Objects**. During placement of geotextile in contact with geomembrane, take care not to entrap stones, sharp objects, or broken needles that could damage geomembrane.

E. **Handling**. Equipment used to handle the geotextile shall not cause damage due to handling, vehicle traffic, excessive heat, leakage of hydrocarbons, or other means.

F. **Damaging Activities**. All personnel working on the geotextile shall not smoke, wear damaging shoes, or engage in other activities which could damage the geotextile.

G. **Timing**. Geotextile should be seamed the same day as it is placed unless otherwise approved by the QA Manager.

H. **Overlaps**. Securing Beneath Rock Channel Protection. Geotextile installed beneath rock channel protection shall be overlapped and secured with pins in accordance with ODOT Specification 601.08.

3.4 REPAIR

A. **Holes or Tears**. Repair any holes or tears in the geotextile as follows:

1. On slopes steeper than 5 horizontal to 1 vertical, a patch made from the same geotextile shall be double seamed into place (with each seam 0.5 inch apart and no closer than 2 inches from any edge). Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced with new material.
2. On slopes flatter than or equal to 5 horizontal to 1 vertical, a patch made from the same geotextile shall be spot-seamed in place with a minimum of 2 feet overlap in all directions.

B. **Foreign Material**. Take care to remove any soil or other material which may have penetrated the torn geotextile.

3.5 SOIL MATERIALS

A. **Placement**. Place all soil materials on top of a geotextile, in such a manner as to ensure that:

1. The geotextile and underlying materials are not damaged.
2. Minimum slippage occurs between the geotextile and underlying layers.
3. Excess stresses are not produced in the geotextile.

3.6 PRODUCT PROTECTION

A. **Prior Work**. Use all means necessary to protect all prior work and materials and completed work of other sections.

B. **Repairs**. In the event of damage, immediately make all repairs and replacements necessary, to the approval of the QA Manager and at no additional cost to the Owner.

3.7 INDEPENDENT QUALITY ASSURANCE

A. **Construction Approval.** The QA Monitor shall inspect the installation of the geotextile to ensure that it is in accordance with the plans and specifications.

Table -1

Cushion Geotextile
(Needle-Punched, Nonwoven)

Properties and Requirements	Qualifier	Units	Specified Values[1]	Test Method
Type	---	---	Nonwoven	---
Polymer Composition	Minimum	%	95% polypropylene or polyester by weight	
<u>High Degree</u>				
Mass Per Unit Area	Minimum	oz/yd^2	16	ASTM D 5261
Grab Strength[2]	Minimum	lb	340	ASTM D 4632
Tear Strength[2]	Minimum	lb	120	ASTM D 4533
Puncture Strength[4]	Minimum	lb	160	ASTM D 4833
Burst Strength	Minimum	psi	550	ASTM D 3786
UV Resistance[3]	Minimum	%	70	ASTM D 4355
<u>Low Degree</u>				
Mass Per Unit Area	Minimum	oz/yd^2	10	ASTM D 5261
Grab Strength[2]	Minimum	lb	270	ASTM D 4632
Tear Strength[2]	Minimum	lb	75	ASTM D 4533
Puncture Strength[4]	Minimum	lb	110	ASTM D 4833
Burst Strength	Minimum	psi	425	ASTM D 3786
UV Resistance[3]	Minimum	%	70	ASTM D 4355

Notes:

(1) All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
(2) Minimum value measured in machine and cross machine direction.
(3) Ultraviolet Resistance requirement is at 500 hours of exposure.
(4) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.

Table -2

Filter Geotextile
(Needle-Punched, Nonwoven)

Properties and Requirements	Qualifier	Units	Specified Values[1]	Test Method
Type	---	---	Nonwoven	---
Polymer Composition	Minimum	%	95% polypropylene or polyester by weight	
Apparent Opening Size Hydraulic Conductivity	Maximum Minimum	mm cm/s	0.300 0.1	ASTM D 4751 ASTM D 4491
Grab Strength[2] Tear Strength[2] Puncture Strength[4] Burst Strength UV Resistance[3]	Minimum Minimum Minimum Minimum Minimum	lb lb lb psi %	160 60 80 275 70	ASTM D 4632 ASTM D 4533 ASTM D 4833 ASTM D 3786 ASTM D 4355
Mass per Unit Area	Nominal	oz/yd^2	6	ASTM D 5261

Notes:

(1) All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
(2) Minimum value measured in machine and cross machine direction.
(3) Ultraviolet Resistance requirement is at 500 hours of exposure.
(4) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.

Table -3

Required Preshipping Testing
of Nonwoven Geotextile

Property	Minimum Quality Control Frequency
Mass Per Unit Area	Every 100,000 ft^2
Mullen Burst Strength	Every 100,000 ft^2
Grab Tensile	Every 100,000 ft^2
Apparent Opening Size	1 per production lot (filter geotextiles only)
Hydraulic Conductivity	1 per production lot (filter geotextiles only)
Puncture Resistance	Every 100,000 ft^2
Trapezoidal Tear	Every 100,000 ft^2

END OF SECTION

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SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** This section includes the clearing and grubbing of the work site and the following:

1. Clearing of area.
2. Grubbing of stumps and roots.
3. Removal of all other vegetation.
4. Protection of designated trees.
5. Removing above- and below grade structures.
6. Disposal off-site of all material generated by the clearing and grubbing operations.

1.3 QUALITY ASSURANCE

Not used.

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

A. **Infrastructure Interference.** Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

B. **Protection.** Provide protection necessary to prevent damage to existing improvements.

C. **Restoration.** Restore all disturbed improvements to their original condition.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. The Contractor shall verify in the presence of the Engineer/Architect the specific areas and limits requiring clearing and grubbing. Also review any trees, shrubs, or other items which are not to be disturbed.

B. **Coordination**. The Contractor shall review with Engineer/Architect or other Owner's Representative requirements of surrounding areas such as adjacent property owners, roads, streets, walks, or other occupied or used facilities. Evidence of proper permission for activities from authorities having jurisdiction shall be given the Engineer/Architect.

3.2 PREPARATION

A. **Safety**. Provide protection as required for surrounding area and operation of any adjoining or affected utilities.

B. **Permits**. Obtain all required permits prior to beginning operations.

3.3 **LANDSCAPE REMOVAL.** Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as required to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. "Removal" includes grubbing and off-site disposing of stumps and roots. Grubbing shall be carried to a depth of 18 inches below existing ground.

3.4 **PROTECTION OF EXISTING TREES AND VEGETATION**. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking, or skinning of roots; skinning or bruising of bark; and smothering of trees by stockpiling construction materials or excavated materials. Provide temporary guards to protect trees and vegetation to remain standing.

3.5 **SALVAGEABLE IMPROVEMENTS**. Carefully remove items indicated to be salvaged, and store on Owner's premises where indicated.

3.6 **BURNING.** The Contractor shall obtain prior approval from Owner and appropriate authorities before any burning will be permitted.

3.7 **DISPOSAL.** All trees, shrubs, plants, and other materials removed shall become the property of the Contractor and shall be removed from the site.

END OF SECTION

SECTION 31 23 00

EXCAVATION, BACKFILL, AND EMBANKMENT

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**. Complete the excavation, backfill, and embankment necessary to construct the work as shown and specified herein. This section includes the following where applicable: structures, underground utilities, and preparing subgrade for pavements, walks, or slabs.

B. **Other Work**. Final grading together with placement and preparation of topsoil for lawns and planting is specified in Section 32 90 02, "Grading and Seeding." Excavation and backfill for buried piping are covered in Division 33.

C. **Definitions**

1. Excavation. The removal of material to required subgrade elevations and disposal of excavated materials.
2. Backfill. Below grade placement and compaction of specified materials to required elevations.
3. Unauthorized Excavation. The removal of materials beyond required subgrade elevations or dimensions without specific direction.
4. Subgrade. The undisturbed earth or the compacted soil layer immediately below foundations, pipe trenches, mud mats, pavement, slabs, walks, base, compacted foundation, embankment, or as shown.
5. Embankment. An engineered fill constructed of compacted, suitable earthen materials used to raise grade to the required elevations.

1.3 **QUALITY ASSURANCE**. Conform all work and materials to the following standards.

A. **ASTM**. American Society for Testing and Materials.

B. **OSHA**. Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Part 1926.650 to .652, Subpart P. Construction Standard for Excavations.

1.4 **SUBMITTALS.** Submit all submittals in accordance with the Division 1 Submittal Requirements and this specification section. Do not deliver or install any materials before Submittal Packages 1 and 2 are approved.

A. **Submittal Package No. 1 – Product Data and Test Laboratory Qualifications**

1. Submittal package shall include:

a. Product data noting each material source, location, sieve analysis, and other information which will show that the source and supplier are capable of furnishing materials meeting the requirements of these specifications. Submit name and location of all borrow pits.
b. Name and address of acceptable test laboratory including the name and experience of the Engineer assigned to the field testing.

B. **Submittal Package No. 2 – Samples**

1. Samples shall include:

a. Aggregate samples not less than 1/4 cubic foot each for the following:

1) Granular backfill.
2) Porous backfill.
3) Base.
4) Drainage Base.

b. Filter Fabric. One-foot-square section.

C. **Submittal Package No. 3 – Field Test Reports**

1. Submit test reports within 48 hours of completion, suspension, or termination of testing the material including a copy of each test report called for in this section.

1.5 **JOB CONDITIONS**

A. **Utilities**

1. Existing Utilities.

a. Notify utility companies and locate existing underground utilities in area of work.
b. Where utilities are to remain in place, provide adequate means of support and protection during construction operations.
c. Repair any Contractor-damaged utilities to the owner's satisfaction at the Contractor's expense.

2. Unforeseen Utility Location.

a. Should a utility which is encountered during excavation be unrecorded or recorded incorrectly, consult the utility immediately for directions.
b. Cooperate with the utility or Owner in keeping respective services or facilities in operation.
c. Repair damaged utilities to the satisfaction of the utility owner.

3. Interruption.

a. Do not disrupt existing utilities except when approved.
b. Provide acceptable temporary utility services unless approved otherwise.

4. Notification. Provide a minimum of 48 hours notice to utility companies and Owner or Engineer/Architect before excavating or interrupting utilities.

B. **Blasting**. Do not blast.

C. **Borrow.** Should the excavated material be insufficient to provide all of the fill required, supply satisfactory material from another source at no cost to the Owner.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Topsoil**

1. Remove, stockpile, and place in the areas to be seeded topsoil that is available as a part of the excavated materials.
2. Shape stockpile and grade to drain.

B. **Excavated Material**. Stockpile excavated material when suitable for use as backfill or embankments onsite as directed.

C. **Stockpiles**. Shape and grade stockpile. Handle the material so that the gradation remains uniform and foreign material is not incorporated into the mix.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **General**. All materials shall be free of elastic soil materials, debris, waste, frozen material, vegetation, organics, peats, or other deleterious material.

B. **Backfill and Embankment**

1. Soil.

a. Earth materials which have resulted from natural processes such as weathering, decay, and chemical action.
b. More than 35 percent weight of the grains or particles will pass a No. 200 sieve and have a plastic index of 4 or more.
c. Free of aggregate or rock larger than 2 inches in any dimension.

2. Aggregate Material.

   a. Natural mineral aggregate such as gravel, crushed gravel, crushed rock, or sand.
   b. At least 65 percent by weight of the grains or particles will be retained on a No. 200 sieve.
   c. At least 90 percent by weight of the grains or particles shall pass the 3-inch sieve.
   d. Remove rock pieces larger than 6 inches in any dimension.
   e. When the major portion of the unsound material in a coarse aggregate acquires a mud-like condition when tested for soundness, ensure that the maximum loss for all uses is 5 percent.

3. Shale. Finely stratified, laminated material formed by consolidation in nature, mudstone, claystone, siltstone, and clay bedrock. Break into predominantly fine particles which can be readily tested for compaction requirements as soil.

4. Rock. Sandstone, limestone, dolomite, glacial boulders, and old concrete which are crushed into pieces that can readily be incorporated into a specified lift thickness and compacted according to requirements for granular aggregate materials.

C. **Granular Backfill**.

1. Granular backfill shall be crushed or uncrushed granular material meeting the following grading requirements:

Sieve	**Total Percent Passing**
2-1/2 inch	100
1 inch	70 – 100
No. 4 (3/16 inch)	25 – 100
No. 40	10 – 50
No. 200	5 – 15

2. The fraction passing a No. 40 sieve shall have a liquid limit not greater than 30 and a plasticity index not greater than 6.
3. Maximum loss during an AASHTO T104 5-cycle sulfate soundness test shall be 15 percent.
4. Maximum wear during an AASHTO T-96 Los Angeles abrasion test shall be 50 percent.

D. **Porous Backfill**.

1. Porous backfill shall be granular material meeting the requirements of ASTM D 448, No. 57, 67, or 78 size.
2. Maximum loss during an AASHTO T104 5-cycle sulfate soundness test shall be 15 percent.

3. Maximum wear during an AASHTO T-96 Los Angeles abrasion test shall be 40 percent.

E. **Mud Mat**. Unless shown or directed otherwise, all mud mats shall be concrete.

1. Concrete. A concrete mud mat shall consist of a 3-inch layer of Class C concrete.
2. Granular Material. A granular mud mat shall consist of a 4-inch layer of crushed aggregate meeting the requirements of porous backfill.

F. **Base**.

1. Base shall be crushed granular material meeting the following grading requirements:

Sieve	Total Percent Passing
2 inch	100
1 inch	70 – 100
3/4 inch	50 – 90
No. 4	30 – 60
No. 30	9 – 33
No. 200	0 – 15

2. Maximum loss during an AASHTO T104 5-cycle sulfate soundness test shall be 15 percent.
3. Maximum wear during an AASHTO T-96 Los Angeles abrasion test shall be 50 percent.

G. **Drainage Base**. Drainage base shall be crushed granular material meeting the requirements of ASTM D 448 No. 57, 67, or 78 size. Meet soundness and abrasion requirements in accordance with porous backfill.

H. **Filter Fabric**. Furnish Type D filter fabric unless shown otherwise. The fabric shall be composed of strong, rotproof, polymeric fibers formed into a woven or nonwoven fabric conforming to the following requirements.

Type A: Underdrains and Slope Drains		
Minimum Tensile Strength	ASTM D 4632	80 lb (335 N)
Minimum Puncture Strength	ASTM D 4833	25 lb (110 N)
Minimum Tear Strength	ASTM D 4533	25 lb (110 N)
Apparent Opening Size	ASTM D 4751	
Soil Type 1: Soils with 50% or less passing No. 200 (75µm) sieve		AOS $\leq$0.6 mm
Soil Type 2: Soils with 50 to 85% passing No. 200 (75 µm) sieve		AOS $\leq$0.3 mm
Minimum Permeability	ASTM D 4491	$1x10^{-2}$ cm/sec
Type B: Filter Blankets for Rock Channel Protection		
Minimum Tensile Strength	ASTM D 4632	200 lb (890 N)
Minimum Puncture Strength	ASTM D 4833	80 lb (355 N)
Minimum Tear Strength	ASTM D 4533	50 lb (220 N)

Minimum Elongation	ASTM D 4632	15%
Apparent Opening Size	ASTM D 4751	AOS ≤0.6 mm
Minimum Permeability	ASTM D 4491	$1x10^{-3}$ cm/sec
Type C: Sediment Fences		
Minimum Tensile Strength	ASTM D 4632	120 lb (535 N)
Maximum Elongation at 60 lb (265 N)	ASTM D 4632	50%
Minimum Puncture Strength	ASTM D 4833	50 lb (220 N)
Minimum Tear Strength	ASTM D 4533	40 lb (180 N)
Apparent Opening Size	ASTM D 4751	AOS ≤0.84 mm
Minimum Permittivity	ASTM D 4491	$1x10^{-2}$ sec^{-1}
Ultraviolet Exposure Strength Retention	ASTM D 4355	70%
Type D: Subgrade-Base Separation or Stabilization		
Minimum Tensile Strength	ASTM D 4632	180 lb (800 N)
Maximum Elongation at 170 lb (755 N)	ASTM D 4632	35%
Minimum Tear Strength	ASTM D 4533	70 lb (310 N)
Minimum Puncture Strength	ASTM D 4833	70 lb (310 N)
Apparent Opening Size	ASTM D 4751	Same as Type A
Permeability	ASTM D 4491	$1x10^{-3}$ cm/sec
Type E: Pavement Reinforcement Fabric		
AASHTO M 288, Section 9, Table 7		

All minimum strengths shown are average roll minimum values in the weakest principal direction.

Ensure that the fabric is free of any treatment that might significantly alter its physical properties. During shipment and storage, wrap the fabric in a heavy-duty protective covering to protect it from direct sunlight, dirt, dust, and other debris.

I. **Filter Fabric Securing Pins**

1. 3/16-inch minimum diameter.
2. Steel.
3. Pointed at one end.
4. Fabricated with a head to retain a steel washer having an outside diameter not less than 1-1/2 inches.
5. At least 18 inches long.

J. **Topsoil**. In accordance with Section 32 90 02, "Grading and Seeding."

PART 3 - EXECUTION

3.1 **EXAMINATION**. Verify actual field/site conditions and confirm grades, elevation, and other pertinent information before beginning excavation.

3.2 **PREPARATION**

A. **Notify all utilities** and adjacent owners of structures or pavements of the excavation.

B. **Notify owners** of adjoining properties or utilities in case of emergencies.

3.3 EXCAVATION

A. **Topsoil**. Remove topsoil and place in separate stockpile.

B. **Protection**

1. Excavations. Protect all excavations by bracing, sheeting, piling, slope benching, or other acceptable means in accordance with OSHA 29 CFR Part 1926.650 to .652, Subpart P. Be responsible for protection of the excavation at all times.
2. Existing Structures. Protect existing structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout, and other hazards created by construction operations including dewatering operations.
3. Barricade open excavations.

C. **Drainage**

1. Direct surface water away from excavations to prevent erosion and undermining of foundations.
2. Provide and maintain diversion ditches, dikes, and grading as necessary during construction.
3. Protect excavated slopes and backfill surfaces to prevent erosion and sloughing.
4. Perform excavation so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

D. **Dewatering**

1. Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift, and heave in the excavation.
2. Do not use French drains, sumps, ditches, or trenches within 3 feet of the foundation of any structure unless authorized.
3. Take control measures by the time the excavation reaches the groundwater level in order to maintain the integrity of the in situ material.
4. While the excavation is open, maintain the water level a sufficient distance below the working level to provide a stable working surface.

E. **Rock Excavation**

1. Definition.

a. Rock excavation is defined as the removal of:

1) Unanticipated solid concrete (excluding pavements), unanticipated solid masonry, or boulders each of which has a volume greater than 1 cubic yard.

2) Bedrock which requires for its removal drilling and blasting, wedging, sledging, barring, or breaking up with a power-operated tool.

b. Rock excavation is not excavating:

1) Existing concrete or masonry structures or pavements shown.
2) Material which can be excavated using an appropriately sized, heavy-duty, power-operated excavator, backhoe, or shovel, all of which are equipped with bucket-mounted ripping teeth.
3) Material that can be excavated with a hand pick and shovel.
4) Soft or disintegrated bedrock such as weathered shale, clay shale, claystone, or mudstone, or overconsolidated soils such as "hardpan."
5) Previously blasted materials or materials that are intermittently drilled and blasted to merely increase production.

2. Blasting. Do not blast unless approved.

3. Limits. Unless otherwise noted, excavate rock to the bottom of structures and to a minimum clear width of 6 inches around the outer limits of the structures.

F. **Disposal**. Dispose of all excavated material unless otherwise shown.

1. Excavated material which is satisfactory may be used for backfill and embankments.
2. Dispose of excavated material which is unsatisfactory or surplus at an Owner approved facility.

G. **Excavation for Structures**. Conform to required elevations and dimensions within a tolerance of 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and inspection.

1. Excavations for Footings and Foundations.

a. Do not disturb bottom of excavation.
b. Excavate by hand to final grade just before concrete reinforcement is placed.
c. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavations for Pile Foundations.

   a. Stop excavations from 6 inches to 12 inches above bottom of pile cap before piles are placed.
   b. After piles have been driven, remove loose and displaced material.
   c. Excavate to final grade, leaving solid base to receive concrete pile caps.

H. **Excavation for Pavements**. Excavate under pavements to comply with required cross sections, elevations, and grades.

3.4 SUBGRADE

A. **Freeze Protection**. Protect the following from freezing:

1. Excavation bottoms or material on which foundations will be constructed.
2. Constructed foundations.
3. Subgrades.

B. **Disturbed Subgrade**. Using an approved method, remediate disturbed subgrade caused by inundation or inadequate dewatering procedures. Perform these remedial measures at no cost to the Owner.

C. **Mud Mat**. Provide a mud mat as shown or where site conditions require a mud mat to protect subgrade.

D. **Unauthorized Excavation**. Backfill unauthorized excavation below design elevations with Class C concrete or other approved material at no cost to the Owner.

E. **Unsuitable Bearing Materials**. Remove unsuitable bearing materials encountered at design elevations and replace with a suitable bearing material as directed.

F. **Shape the subgrade** at all foundations, slabs, and pavements so that the required thickness of the foundations, slabs, pavements, and granular material can be maintained.

G. **Pavement and Slab Subgrade**

1. Compact all pavement and slab subgrades to a depth of 12 inches.
2. Replace subgrade soils with a maximum dry density of less than 100 pounds per cubic foot under pavement and slabs with suitable soil or granular material.
3. Compact soil subgrades with a maximum dry density of 100 to 105 pounds per cubic foot to at least 102 percent.
4. Compact all other soil subgrades to at least 100 percent.
5. The moisture content shall be between the optimum moisture content and 3 percent above the optimum moisture content.

H. **Proofrolling**

1. Unless directed otherwise, proofroll all subgrades for pavements, slabs, and embankments.
2. Remove debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to proofrolling and placement of fill for embankment.
3. The proofrolling equipment shall consist of an acceptable pneumatic-tired vehicle such as a loaded dump truck.
4. The gross load of the vehicle shall be at least 25 tons.
5. Roll the entire plan area of the subgrade with at least two passes of the vehicle or as directed.
6. Adjacent passes shall be offset no more than 6 inches to provide complete coverage of the area.
7. Remove and replace any soft, wet, or weak areas detected by the proofrolling with acceptable material or scarify, moisture-condition, and recompact.

I. **Filter Fabric**

1. Surfaces to receive fabric shall be relatively smooth and free of obstructions and debris.
2. Place the fabric loosely without wrinkles and creases.
3. Where joints are necessary, place strips to provide a 12-inch minimum overlap.
4. Place securing pins with washers at 2-foot intervals along joints and at 5-foot intervals elsewhere to prevent slippage of the fabric.

3.5 BACKFILL AND EMBANKMENTS

A. **General**

1. Place and compact backfill material as shown and specified in this section.

2. Adjacent to structures:

   a. Use backfill where it will support landscaping.
   b. Use granular backfill where it will support structures and slabs.

3. Backfill excavations as promptly as work permits, but not until completion of the following:

   a. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   b. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
   c. Removal of concrete formwork.
   d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent

settlement of the structure or utilities, or leave in place if required.

e. Removal of trash and debris from excavation.

f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

g. After the first floor slab has been poured and set on building walls, unless otherwise approved.

h. Testing water-bearing walls for watertightness.

B. **Placement**

1. Backfill against other work shall be in a manner and at such time as not to endanger the stability or damage the work.

2. Do not place any lift on surfaces that are muddy or frozen, or contain frost or ice.

3. Place backfill and fill materials evenly around structures, piping, or conduit to required elevations.

4. Place granular materials after the subgrades have been leveled.

5. Unless noted otherwise, all references to degree of compaction are expressed as a percentage of the maximum dry density in accordance with ASTM D 698 (standard Proctor).

6. Before compaction, moisten or aerate each lift as necessary to provide appropriate moisture content.

7. Place and compact materials in lifts as specified in the following paragraph.

   a. Backfill.

      1) Maximum 6-inch loose layers unless using hand tampers.
      2) Maximum 4-inch loose layers when hand-operated tampers are used.
      3) Compact each layer to at least 95 percent unless noted otherwise.
      4) Compact backfill for voids, depressions, or holes resulting from the demolition of existing structures to 100 percent.
      5) Moisture content between 1 percent below optimum and 3 percent above optimum.

   b. Granular Backfill.

      1) Maximum 6-inch loose layers unless using hand tampers.
      2) Maximum 4-inch loose layers when hand operated tampers are used.

3) Compact each layer to at least 100 percent.
4) Moisture content at or near optimum.

c. Base.

1) Maximum 6-inch compacted layers.
2) When shown as more than 6 inches thick, place material in equal layers but no layer more than 6 inches compacted thickness.
3) When supporting a structure or slab, compact each layer to at least 100 percent.
4) In all other situations, compact each layer to at least 98 percent.
5) Moisture content within 1 percent of the optimum.

d. Porous Backfill.

1) Maximum 6-inch compacted layers.
2) Compact each layer to at least 95 percent unless supporting a structure if supporting a structure, compact to 100 percent.

e. Granular Mud Mat. Compact at least 100 percent.

f. Drainage Base.

1) Maximum 6-inch compacted layers.
2) When shown as more than 6 inches thick, place material in equal layers but no layer more than 6-inch compacted thickness.
3) Compact each layer to at least 100 percent.

8. Moisture Conditioning.

1) Where the subgrade or a lift of soil material must be moisture conditioned before compaction, uniformly apply water to surface.
2) Apply water sparingly to prevent free water from appearing on surface during or subsequent to compaction operations.

C. **Grading**

1. Smooth the finished surface within specified tolerances.

2. Grade and compact areas with uniform slopes between required elevations or between such points and existing grades.

3. Grade areas to drain away from structures and to prevent ponding.

4. Finish surfaces free from irregular surface changes and as follows:

a. Lawn or Unpaved Areas. Grade areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
b. Pavements and Walks. Shape surface of areas under pavement to line, grade, and cross section, with surface not more than 1/2 inch above or below required subgrade elevation.

D. **Embankments**

1. Continuously bench sloped surfaces steeper than 1 vertical to 8 horizontal so that embankment material will bond with existing surface.

2. Maximum 6-inch loose layers.

3. Compact each layer to the minimum percent of maximum dry density specified herein.

Compaction Maximum Dry Density lbs/cf	**Minimum Percent Maximum Dry Density**
90-104.9	102
105-119.9	100
120 and more	98*

*100 if embankment supports a structure foundation.

4. Moisture Content.

a. The moisture content shall be between the optimum moisture content and 3 percent above the optimum moisture content.
b. For material which displays pronounced elasticity or deformation under action of compaction equipment, reduce the moisture content to optimum to secure stability.

3.6 FIELD QUALITY CONTROL

A. **Field-Testing**

1. Test Laboratory. Employ an acceptable soils testing laboratory to determine the following:

a. Moisture density relationship of the materials to be compacted.
b. Field moisture and density to verify the degree of compaction being obtained.
c. The strength of subgrades supporting structures.

2. The soils testing laboratory personnel shall be on-site continuously during all placement and compaction activities including backfills and embankments to determine compliance with this specification section.

3. Tests will be located by the Engineer/Architect.

4. Allow testing services to inspect and approve subgrades, backfill, drainage fill, and embankment layers before further construction work is performed.

5. Perform field density tests as follows, in accordance with ASTM D 1556 or D 2922. Perform footing subgrade strength tests using acceptable calibrated instruments.

   a. Footing Subgrade. Conduct at least one test to verify required design bearing for each footing location. For a strip footing, conduct one test for every 50 linear feet of footing.
   b. Building Slab or Paved Areas. Make at least one field density subgrade test for every 2,000 square feet, but in no case less than three.
   c. Backfill, Base, Drainage Base, and Embankment. Field density tests shall be made at least once for every 50 cubic yards, or fraction thereof, and at least one test per lift (compacted layer).
   d. Wall Backfill. Take at least one field density test, per side, at locations directed for each lift (compacted layer).

6. If the subgrade, backfill, drainage fill, or embankment is below specified density, provide additional compaction and testing at no additional cost to the Owner.

B. **Settling**. Where settling is measurable or observable during construction or within two (2) years following substantial completion, the Contractor shall remove the surface (pavement, lawn, or other finish), add backfill, compact, and replace surface at no cost to the Owner.

3.7 GRADING FOR SEEDING

A. Rough Grading

1. Trim and grade all areas to within 4 inches of the finished grades.
2. These areas are to be free from rock or other foreign material 3 inches or greater in any dimension.

B. **Finished Grading**. Spread topsoil to conform to the required finished grades.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to work specified in this section.

A. **APPENDIX I –GEOTECHNICAL REPORTS.** "Geotechnical Engineering exploration Report" is included for reference to describe the soils and groundwater conditions at the wellfield and Sugar Creek WTP site.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to design and provide dewatering operations in accordance with the drawings and as specified herein.

1. Dewatering consists of lowering and controlling groundwater levels and hydrostatic pressures to permit excavation and construction to be performed "in the dry" condition.

1.3 **QUALITY ASSURANCE**

A. **Codes and Regulatory Agencies**. Perform all dewatering work in conformance with all federal, state, and local codes and regulatory agencies.

B. **Permits**. Obtain all necessary groundwater withdrawal and discharge permits and file required reports with governing agencies having jurisdiction.

C. **Operator Qualifications**. Perform dewatering operations with supervisory personnel having at least 5 years' experience in field of dewatering.

D. **Supervision**. Maintain adequate supervision and control to ensure that stability of excavated and constructed slopes is not adversely affected by water, erosion is controlled, and flooding of excavation or damage to structures does not occur.

1.4 **SUBMITTALS**

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Dewatering Plan**

1. Submit the dewatering plan for review and comment. Deliver or install no equipment before this submittal package has been reviewed and approved. Submittal package shall include:

a. Reports. Furnish test reports and material certifications as required.
b. Dewatering Plan. Provide layout of proposed dewatering system, methods and means of disposal, and details of coordination with other construction activities.

C. **Submittal Package No. 2 – Observation Well Readings**

1. Submit observation well readings within 7 days of the time the measurement was recorded for review including the following:

a. Observation Well Readings. Provide daily observation well reports recording elevation of groundwater.

1.5 **JOB CONDITIONS**

A. **Existing Facilities**. Provide dewatering system that does not have negative impacts on surrounding structures or disrupt existing private wells or water supply systems.

B. **Coordination - Interfacing**. Coordinate dewatering procedures with all other trades to prevent delays, errors, or omissions.

C. **Operation and Maintenance.** Provide all necessary labor, material, tools, and equipment to furnish and install a complete and operable dewatering system including well casings, piping, valves, pumps, controls, 3-stage sedimentation basin, fuel and supplies to operate and maintain the dewatering system(s) required to permit excavation and construction to be performed “in the dry” until dewatering is no longer required to complete the improvements.

1.6 **DELIVERY, STORAGE, AND HANDLING**

Not used.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 **EXAMINATION**. Verify actual field/site conditions and confirm grades, elevations, and any other pertinent information prior to beginning dewatering operations.

3.2 **PREPARATION**

A. **Protection**. Protect existing structures from damage during all phases of dewatering operations.

3.3 **DEWATERING**

A. **General**. Provide an adequate dewatering system to lower and control groundwater in order to permit excavation, construction of structures, and placement of fill materials in "dry" conditions.

1. Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift, and heave in the excavation and to eliminate interference with orderly progress of construction. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, maintain the water level a minimum of 3 feet (or more) below the working level as required to sufficiently provide a stable working surface.

B. **Miscellaneous**. Prior to excavation below groundwater level, place system into operation to lower water levels as required and then operate it continuously 24 hours a day, 7 days a week until drains, sewers, and structures have been constructed, including placement of fill materials, and until dewatering is no longer required.

C. **Disposal**. Dispose of water removed from excavations in a manner to avoid endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner to avoid inconvenience to others. Provide sumps, sedimentation tanks, and other flow control devices as required by governing authorities.

D. **Standby Equipment**. Provide standby equipment on site, installed and available for immediate operation to maintain dewatering on a continuous basis in event any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to the Owner.

E. **Remedial Measures**. Dewatering shall be performed in a manner that will result in an undisturbed foundation bearing surface at the required foundation elevation. Correct disturbed or unsuitable foundation bearing surfaces resulting from inadequate dewatering methods at no cost to the Owner.

3.4 OBSERVATION WELLS

A. **General**. Four existing observation (monitoring) wells (MW-1 thru MW-4) are located on site around the perimeter of the proposed tank as shown on the plans. Groundwater depth readings from 2018 are summarized in a table at the end of Appendix I-2. These monitoring wells shall remain and be monitored by the contractor during construction. If an existing monitoring well interferes with the contractor's construction operations it may be removed and replaced with a new well at a similar location approved by the Engineer. Any new well construction details shall be approved by the Engineer. Provide, take measurements, and maintain the minimum number of observation wells indicated on the plans, or any observation wells required by governing authorities, or any observation wells necessary to ensure protection of surrounding structures or water supply systems.

B. **Monitoring**. Observe and record daily elevation of groundwater levels in observation wells while dewatering operations are required.

C. **Replacement.** Repair or replace within 24 hours, observation wells that become inactive, damaged, or destroyed. If required, suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation well risers to demonstrate that observation wells are functioning properly.

3.5 DEWATERING SYSTEM REMOVAL

A. **Removal**. When the dewatering system is no longer required, remove the system to the satisfaction of the Owner. This includes removal of all pumps, casings, pipes, and other materials and equipment used for the dewatering system.

B. **Well Abandonment**. Remove all dewatering and observation wells in accordance with appropriate well abandonment procedures of governing agencies having jurisdiction including complete grouting when required.

3.6 REPAIR/RESTORATION

A. **Site Work**. Repair site to a condition acceptable to the Owner and similar to the existing site conditions prior to performing dewatering work. This includes filling holes, trenches, pits, and depressions in a satisfactory manner. Repair eroded areas including revegetating where necessary.

END OF SECTION

SECTION 31 23 23.14

TRENCH GRANULAR BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and place the trench granular backfill in accordance with the plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work required to furnish and place the granular backfill in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1.4 SUBMITTALS

A. **Transmittals.** Furnish manufacturer's product data, test reports, and materials certifications as required.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **Granular Backfill**. Granular backfill material shall be gravel, crushed gravel, or crushed stone meeting the following grading requirements:

Sieve	Total Percent Passing
2-1/2	100
1 inch	70-100
No. 4 (3/16 inch)	25-100
No. 40	10-50
No. 200	5-15

The fraction passing a No. 40 sieve shall have a liquid limit not greater than 30 and a plasticity index not greater than 6.

B. **Backfill.** Backfill around polyvinyl chloride (PVC) water line pipe shall not exceed a maximum size of 100 percent passing the 1-1/2 inch screen.

C. **Trench-Excavated Granular Material**. Excavated granular material meeting the material specification and as approved by the Engineer/Architect may be used as granular backfill.

PART 3 - EXECUTION

3.1 **INSTALLATION**. General. Place material in layers to required elevations for each area classification listed below, using materials specified in Part 2 of this section.

1. Under walks and pavements, use base material, backfill, or a combination.

2. Adjacent to structures, use backfill material.

3. Under piping, conduit, and equipment, use base materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder. From bottom of piping and conduit to 12 inches above piping and conduit, use fill except 100 percent of aggregate should pass 1-inch sieve.

4. Backfill excavations as promptly as work permits, but not until completion of the following:

   a. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded. Backfill trenches when authorized by Engineer/Architect.
   b. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
   c. Removal of trash and debris from excavation.

B. **Placement.** No material shall be placed until such work has been observed by the Engineer/Architect and approved. No material shall be placed over snow or frozen material.

1. Place materials specified in Part 2 in lifts as specified below. Before compaction, moisten or aerate each lift as necessary to provide appropriate moisture content. Compact each lift to required percentage

of maximum dry density for each area classification. Do not place any lift on surfaces that are muddy or frozen, or contain frost or ice.

2. Place backfill and fill materials evenly adjacent to piping, or conduit to required elevations. Use care in backfilling of trenches to avoid damage or displacement of piping and conduits.

3. Control all compaction and provide minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts of soils if soil density tests indicate inadequate compaction.

4. Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances; compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

5. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:

    a. Lawn or Unpaved Areas. Grade areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
    b. Walks. Shape surface of areas under walks to line, grade, and cross section, with surface not more than 0.05 foot above or below required subgrade elevation.
    c. Pavements. Shape surface of areas under pavement to line, grade, and cross section, with surface not more than 1/2 inch above or below required subgrade elevation.

6. Placement. Type of granular material shall be placed where shown on the drawings and as specified.

C. **Compaction**

1. Each layer shall be compacted to not less than 95 percent of maximum dry density. The moisture content shall be not greater than 1 percentage point below optimum moisture content and not greater than 3 percentage points above optimum moisture content.
2. Granular Backfill. Granular backfill shall be placed in not more than 6 inch loose layers, 4 inch loose layers when hand operated tampers are used, and each layer compacted to not less than 100 percent of maximum dry density. The moisture content shall be at or near optimum moisture content.

3.2 FIELD QUALITY CONTROL

A. Testing

1. Allow testing services to inspect and approve backfill, and fill layers before further construction work is performed.

2. Perform field density or strength tests as follows, in accordance with American Society for Testing and Materials (ASTM) D 698, D 1556, and D 2922.

    a. Building Slab or Paved Areas. Make at least one field density test of subgrade for every 2,000 square feet, but in no case less than three.
    b. Backfill and Drainage Base. Field density tests shall be made at least once for every 250 cubic yards, or fraction thereof, of compacted material.

3. If the specified compacted materials are found to be below specified density, provide additional compaction and testing at no additional cost to the Owner.

4. **Settling**. Where settling is measurable or observable during construction or within two (2) years following substantial completion, the Contractor shall remove the surface (pavement, lawn, or other finish), add backfill, compact, and replace surface at no cost to the Owner.

END OF SECTION

SECTION 31 23 23.23

COMPACTED FOUNDATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to install the compacted foundation in accordance with the drawings and specifications.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform excavation work in compliance with all federal, State, local codes, and regulatory agencies.

1. OSHA – Occupational Safety and Health Administration.

a. OSHA 29 Code of Federal Regulations (CFR) Part 1926.650 to .652, Subpart P. Construction Standard for Excavations.

B. **Standards**. Conform all work and materials to the following standards.

1. ASTM – American Society for Testing and Materials.

1.4 SUBMITTALS

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Product Data**

1. Product Data. Submit material source name and location, sieve analysis, and other information which will show that the source and supplier are capable of furnishing the specified materials.
2. Samples. Submit a 1/4-cubic-foot sample of each type of compacted foundation material to be used.
3. Laboratory. Submit name and address of laboratory including the name and experience of the Engineer assigned to do field testing.

C. **Submittal Package No. 2 – Test Reports**

1. Tests. Submit two copies of each test report called for in this section.

1.5 **JOB CONDITIONS**

A. **Cooperation**. Cooperate with the soils testing laboratory and provide access to the site for testing.

B. **Compacted Foundations Subgrade Preparation**

1. All material shall be place on compacted subgrade prepared in accordance with Specification 02 31 23 00 Excavation, Backfill, and Embankment, in accordance with the requirements that meet ODOT Item 204 Compacted Backfill. Soils tests shall be completed by independent soils testing firm retained by the Contractor, and sampled prior to placement of compacted foundation materials.
2. Coarse Aggregate Placement on Compacted Subgrades. Where excavations that have been completed to the elevation or grade of the proposed subgrade, cannot be compacted to meet requirements of Specification 02 31 23 00 Excavation, Backfill, and Embankment, the defective materials will be removed and replaced with compacted Foundation Cushion the comply with the requirements of Section 31 23 23.23 as directed and approved by the Owner and Engineer.
3. Compacted Foundation Materials under Lagoon Concrete Slabs, Structures, and Manholes. The Contractor will place compacted foundation material to the elevations and grades shown on the plans at the thicknesses shown on the plans that conform to Paragraph 2.1 B Granular Material. All compacted granular materials shall be compacted graded, and tested, and a written report issued to the Engineer that the materials are suitable and ready to support proposed foundations, slabs, and structures.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. In accordance with Section 01 60 00, "Materials and Equipment."

1. Stockpile material in designated areas.
2. Avoid segregation.
3. Do not contaminate stockpiled material with foreign materials.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIAL**

A. **Coarse Aggregate**. Coarse aggregate shall consist of No. 1 or No. 2 size coarse aggregate such as gravel or crushed rock and meet the following grading:

Sieve	Total Percent Passing – No. 1	Total Percent Passing – No. 2
4 inch	100	--
3-1/2 inch	90 – 100	--

3 inch	--	100
2-1/2 inch	25 – 60	90 – 100
2 inch	--	35 – 70
1-1/2 inch	0 – 15	0 – 15
1 inch	--	--
3/4 inch	0 – 5	0 – 5
No. 4 (3/16 inch)	--	--
No. 30	--	--
No. 200	--	--

B. **Granular Material**. Granular material shall consist of crushed granular material, such as crushed gravel or crushed rock, and meet the following grading:

Sieve	Total Percent Passing Granular Material
2 inch	100
1 inch	70 – 100
3/4 inch	50 – 90
No. 4	30 – 60
No. 30	9 – 33
No. 200	0 – 15

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Commence removal of existing material below the foundation subgrade after it has been designated to be removed, unless shown otherwise by the drawings.

3.2 INSTALLATION

A. Coarse Aggregate

1. The use of coarse aggregate must be authorized before it can be used on the project.
2. Coarse aggregate may be used when dewatering and site groundwater conditions are restricted and water remains in the excavated area to receive compacted foundation.
3. Place coarse aggregate in loose layers 8 inches to 12 inches in depth.
4. Thoroughly track in place by crawler-type tractors.
5. Place the coarse aggregate in a maximum of 1 foot of water and carry to a maximum of 1 foot above the level of the water.

B. Granular Material

1. Place granular material in the dry and above any coarse aggregate.

2. Granular Material.

a. Place granular material in 6-inch loose layers with each layer compacted to a minimum of 100 percent of maximum dry density.
b. The moisture content shall be at or near optimum.
c. Accomplish compaction with acceptable equipment.

3.3 FIELD QUALITY CONTROL

A. General

1. Employ an acceptable testing laboratory to determine the following:

a. The moisture density relationship of the material to be compacted in accordance with ASTM D 698.
b. The degree of compaction obtained in accordance with ASTM D 1556 or D 2922.
c. The strength of structure subgrades.

2. The soils testing laboratory personnel shall be on-site during all placement and compaction activities involving compacted foundation to determine compliance with this specification section.

3. Test every 50 cubic yards or fraction thereof, or at least once per layer for each area of compacted granular material.

4. Test locations will be selected by the Engineer/Architect.

END OF SECTION

SECTION 31 50 00

EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to work specified in this section.

B. **SECTION 05 10 00 - STRUCTURAL STEEL**

C. **SECTION 31 62 16_13 - STEEL SHEET PILING**

D. **SECTION 31 75 00 - DRILLED SHAFTS**

E. **SECTION 31 23 19 – DEWATERING.** Contractor shall be responsible for dewatering operations required for lowering and controlling groundwater levels and hydrostatic pressures to permit excavation and construction to be performed "in the dry" condition per the requirements outlined in this specification.

F. **APPENDIX I –GEOTECHNICAL REPORTS.** A Geotechnical Engineering exploration Report is included for reference to describe the soils and groundwater conditions at the site .

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install excavation support systems in accordance with the drawings and as specified herein.

B. **General**. This section includes, but is not limited to, the following:

1. Shoring and bracing necessary to protect existing structures, streets, walkways, utilities, and other improvements and excavation against loss of ground or caving embankments.
2. Maintenance of shoring and bracing.
3. Removal of shoring and bracing, as required.

C. **Support Systems**. Types of shoring and bracing systems include, but are not limited to, the following:

1. Steel H-section (soldier) piles and timber lagging.
2. Steel sheet piles.
3. Pipe and Z Sheet Piling Combined Wall Systems
4. Auger cast pile walls.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform excavation and backfill work in compliance with all federal, state, and local codes and regulatory agencies including the following:

1. OSHA – Occupational Safety and Health Administration.

a. OSHA 29 Code of Federal Regulations (CFR) Part 1926.650 to .652, Subpart P. Construction Standard for Excavations.

B. **Engineer Qualifications**. When required, retain the services of a qualified professional engineer to design and lay out the excavation support systems. The engineer shall be legally authorized to practice in jurisdiction where project is located and experienced in providing successful engineering services for excavation support systems similar in extent required for this project.

C. **Supervision**. When required, engage and assign supervision of excavation support system to a qualified professional engineer foundation consultant.

1.4 SUBMITTALS

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings, Engineer Qualifications, and Product Data**

1. Shop drawings, engineer qualifications, and product data shall be submitted to the Engineer for review. No equipment shall be delivered or installed before this submittal package has been reviewed and commented on by the Engineer. Submittal package shall include:

a. Shop Drawings. Submit layout drawings, details, and calculations for excavation support system for review and comment. The review and comment of shop drawings by the Engineer/Architect shall not be construed as an approval of the Contractor's design. The Contractor and the Contractor's consultant shall be totally responsible for the design and construction of the excavation support system.

b. Engineer Qualifications. Submit name and experience of engaged consultant.

c. Product Data. Submit manufacturer's product data, test reports, and material certifications as required.

1.5 **JOB CONDITIONS**

A. **Coordination - Interfacing**. Coordinate excavation support systems with all other trades to prevent delays, errors, or omissions.

B. **Preconstruction Survey**. Before starting work, verify governing dimensions and elevations of pertinent structures. Verify condition of adjoining properties. Take photographs to record any existing settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages, verified by video recording and dated photographs, and signed by Contractor and others conducting investigation.

C. **Survey**. Survey adjacent structures and improvements, employing qualified professional surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. Resurvey benchmarks weekly and during critical points of the excavation, maintaining accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer/Architect if changes in elevations occur or if cracks, sags, or other damage is evident.

D. **Existing Utilities**. Protect existing active sewers, water, gas, electricity, and other utility services and structures. Notify municipal agencies and service utility companies having jurisdiction prior to performing excavation. Comply with requirements of governing authorities and agencies for protection, relocation, removal, and discontinuing of services.

1.6 **DELIVERY, STORAGE, AND HANDLING**

Not used.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **General**. Provide adequate shoring and bracing materials which will support loads imposed. Materials need not be new but shall be in serviceable condition.

B. **Structural Steel**. American Society for Testing and Materials (ASTM) A 36.

C. **Steel Sheet Piles**. ASTM A 328.

D. **Timber Lagging**. Any species, rough cut, mixed hardwood, minimum nominal 3 inches thick, unless otherwise indicated or required.

E. **Steel Pipe Pile.** ASTM A 36 Rolled and Welded Pipe with Z-Sheet Pile Connectors

PART 3 - EXECUTION

3.1 **EXAMINATION**. Verify actual field/site conditions and confirm grades, elevations, and other pertinent information prior to installing excavation support systems.

3.2 **PREPARATION**

A. **Protection**. Protect existing and proposed structures from damage during installation and removal of excavation support systems.

3.3 **SHORING**

A. **Location**. Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring system adequately anchored and braced to resist earth, surcharge, and hydrostatic pressures.

B. **Existing Structures**. Shoring systems retaining earth on which the support or stability of existing structures is dependent must be left in place at completion of work unless indicated otherwise.

3.4 **BRACING**

A. **Location.** Locate bracing to clear columns, floor framing construction, walls, and other permanent work. If necessary, to move a brace, install new bracing prior to removal of original brace. Do not place bracing where it will be cast into, boxed out for, or included in permanent concrete work, except as otherwise acceptable to Engineer/Architect.

B. **Internal Bracing**. Install internal bracing, if required, to prevent spreading or distortion of braced frames.

C. **Maintenance**. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth, surcharge, and hydrostatic pressures.

3.5 **EXCAVATION SUPPORT SYSTEM REMOVAL**

A. **Removal**. When no longer required, remove sheeting, shoring, and bracing in stages to avoid disturbance to underlying soils and excavation walls, and damage to structures, pavements, facilities, and utilities.

3.6 **REPAIR/RESTORATION**

A. **Damages**. Repair or replace, as acceptable to the Owner and Engineer/Architect, adjacent work or structures damaged or displaced through installation, removal, or inadequacy of excavation support systems.

B. **Site Work**. Repair site to a condition acceptable to the Owner and similar to the existing site conditions prior to performing excavation support work. This includes filling holes, trenches, pits, and depressions in a satisfactory manner.

END OF SECTION

SECTION 31 62 16.13

STEEL SHEET PILING

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to design and drive the steel sheet piles according to the plans and as specified herein.

1.3 **QUALITY ASSURANCE**

A. **Codes and Regulatory Agencies**. Perform all work in placement of the steel sheet piling in compliance with all federal, state, and local codes and regulatory agencies including the following:

1. OSHA – Occupational Safety and Health Administration

a. OSHA 29 Code of Federal Regulations (CFR) Part 1926.650 to .652, Subpart P. Construction Standard for Excavations

2. PTI – Post-tensioning Institute

a. Tie-backs shall be designed and installed in accordance with PTI's "Recommendations for Pre-stressed Rock and Soil Anchors".

1.4 **SUBMITTALS**

A. **Transmittals**. Submit manufacturer's product data for each type of sheet pile used.

B. **Mill Test Reports**. Provide mill test reports for all new steel sheet piling if requested. Mill test reports will not be required for used sheet piling, but certification shall be submitted that the material is in accordance with these specifications. Type, weight, and property of sections of steel sheet piling shall be as shown.

1.5 **JOB CONDITIONS**

A. **Adjacent Structures**. No sheet pile driving shall occur within 100 feet of any concrete which has had less than 7-day cure unless acceptable.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**. Deliver materials to the site in a manner so as not to delay the work.

B. **Storage and Handling**. Store and handle materials in such a manner to preserve their quality and fitness for the work. Store piles in orderly groups above ground and blocked to prevent distortion of members.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **General**. All steel sheet piling shall conform to the requirements of American Society for Testing and Materials (ASTM) A 328. Used steel sheet piling, in good condition and acceptable to the Engineer/Architect, may be used.

B. **Interlocks**. The interlocks of sheet piling shall be free sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed. Sheet piling, including special fabricated sections, shall be full length sections of the dimensions shown. Fabricated sections shall conform to the requirements herein and the piling manufacturer's recommendations for fabricated sections.

PART 3 - EXECUTION

3.1 **EXAMINATION**. Verify actual field/site conditions and confirm grades, elevations, and any other pertinent information prior to beginning placement of steel sheet piling.

3.2 **PREPARATION**

A. **Protection**. Protect existing structures from damage during all sheet pile driving operations.

3.3 **INSTALLATION**

A. **General**. Drive steel sheet piling to the penetration shown. Cutoff elevations and any anchors or attachments to structures shall be as shown. Welding shall be performed using the low hydrogen process in accordance with American Welding Society (AWS). If the piling deviates from the vertical to an extent considered detrimental for the intended purpose of the piling, pull and redrive the piling at no cost to the Owner.

B. **Driving Hammers**. Hammers shall be steam, air, or diesel drop, single acting, double acting, differential acting, or vibratory type. The driving energy of the hammers shall be between 7,500 and 15,000 foot-pounds or as recommended by the manufacturer for the piling weights and subsurface materials to be encountered.

C. **Driving**. Prior to driving pilings in water or when directed, paint a horizontal line on both sides of each piling at a fixed distance from the bottom so that it

shall be visible above the water line after installation. This line shall indicate the profile of the bottom elevation of installed pilings, and potential problem areas can be identified by abrupt changes in its elevation. Remove the painted horizontal line from the sheet piling if directed at no cost to the Owner. Drive pilings with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths. Maintain driving hammers in proper alignment during driving operations by use of leads or guides attached to the hammer. Take caution in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock melt or damages. Discontinue the use of vibratory hammers and employ impact hammers when the penetration rate due to vibratory loading is 1 foot or less per minute. Employ a protecting cap in driving when using impact hammers to prevent damage to the tops of pilings. Remove and replace pilings damaged during driving or driven out of interlock at own expense.

D. **Obstructions**. If obstructions restrict driving a piling to the specified penetration, the obstructions shall be removed or penetrated with a chisel beam. If you demonstrate that removal or penetration is impractical, make changes in the design alignment of the piling structure as directed to ensure the adequacy and stability of the structure.

E. **Splices**. Avoid splices to the fullest practicable extent especially where exposed to view. Pilings adjoining spliced pilings shall be full length unless otherwise approved. Square ends of pilings to be spliced before splicing to eliminate dips or camber. Splice pilings together with concentric alignment of the interlocks so that there are no discontinuities, dips, or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings.

F. **Miscellaneous**. Cut holes in pilings for bolts, rods, drains, or utilities as shown or as directed. Do all cutting in a neat and workmanlike manner. Use a straight edge in cuts made by burning to avoid abrupt nicks. Drill bolt holes in steel piling or burn and ream by approved methods which will not damage the surrounding metal. Holes other than bolt holes shall be reasonably smooth and the proper size for rods and other items to be inserted.

G. **Painting**. Painting is required on portions of steel sheet piling exposed to view and as shown on the plans. See Section 09 90 00, "Painting."

END OF SECTION

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SECTION 31 75 00

DRILLED SHAFTS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 specification sections, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**. Provide all labor, tools, equipment, and materials necessary to install the drilled shafts in accordance with the plans and the specifications with the understanding that the actual length required, based on conditions encountered during construction, may differ from the estimated lengths shown. Length shall be defined as the length in feet measured along the axis of the drilled shaft from the bottom of the drilled shaft to the cutoff elevation.

B. **Experience**. All drilled shafts shall be installed by a contractor who is experienced in this type of construction and has the required qualifications.

1.3 **QUALITY ASSURANCE**

A. **Codes and Standards**. Comply with provisions of American Concrete Institute (ACI) 336.1 (most recent edition) "Standard Specification for the Construction of End Bearing Drilled Piers," and as herein specified.

1. Conflicting Regulations. Where provisions of this standard conflict with building regulations in effect for this project, building regulations will govern, but only to establish minimum requirements. In the case where this standard conflicts with requirements of the plans or these specifications, the Contract Documents shall govern.

B. **Survey Work**.

1. Employ, at no cost to the Owner, a registered surveyor or licensed professional engineer to perform surveys, layouts, and measurements for drilled shaft work.
2. Conduct layout work for each drilled shaft to lines and levels required before excavation.
3. Record actual measurements of each drilled shaft location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other data as required.

C. **Concrete Testing Service**.

1. Employ, at no cost to the Owner, an approved testing laboratory to perform the testing specified in ACI 301 Chapter 16 and as specified herein.
2. The testing laboratory shall meet the requirements of American Society for Testing and Materials (ASTM) E 329.

3. Testing shall be made by an ACI concrete field testing technician Grade 1 or approved equivalent.
4. A Technician Grade 1 shall be present during all concrete placement.
5. For concrete placed under water, hire an approved testing laboratory to design the mix and perform the Corps of Engineers CRD C61 tests.

D. **Geotechnical Testing Firm**.

1. Employ, at no cost to the Owner, a qualified geotechnical engineer experienced in drilled shaft construction.
2. The geotechnical engineer shall continuously monitor drilling and installation procedures, determine bearing capacity of drilled shafts, and assist in the resolution of drilled shaft construction related questions.
3. The geotechnical testing firm shall be approved.

E. **Qualifications**

1. Drilled shaft Contractor shall have not less than five successfully completed contracts with similar soil conditions, groundwater conditions, drilled shaft sizes, depths, and volumes of work contained in this project.
2. Geotechnical testing firm shall have provided inspection services on not less than three projects with similar soil conditions, groundwater conditions, drilled shaft sizes, depths, and volumes of work contained in this project.

1.4 **SUBMITTALS.** Submit all submittals in accordance with the Division 1 submittal requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Qualifications**

1. Perform no drilled shaft construction or testing services before this submittal package has been reviewed and approved.
2. Qualifications data shall include:

    a. Drilled shaft Contractor qualifications.
    b. Concrete testing service qualifications.
    c. Geotechnical testing firm qualifications.

B. **Submittal Package No. 2 – Installation Plan**

1. At least 21 days prior to construction of the drilled shafts, submit for review a written plan of the proposed steps and procedures for construction of the drilled shafts. Include in this written plan a detailed method for each of the following items:

    a. Casing installation.
    b. Excavation of drilled shaft.
    c. Dewatering of drilled shaft.
    d. Determination of drilled shaft bearing capacity.
    e. Concrete placement.
    f. Removal of casings.
    g. Drilled shaft sequence of installation.

2. Do not construct any drilled shafts until this submittal has been reviewed.

C. **Submittal Package No. 3 – Concrete Mix Design**

1. At least 14 days prior to concrete placement, submit the concrete mix design and materials certification test reports for cement, aggregates, and admixtures.
2. Submit a detailed plan for concrete placement.
3. Place no concrete until this submittal has been reviewed.

D. **Submittal Package No. 4 – Drilled Shaft Report**

1. Submit a preliminary drilled shaft report by the geotechnical testing firm for each drilled shaft stating that the bottom of each drilled shaft is founded upon satisfactory bearing material for the design allowable bearing capacity.
2. Submit a certified drilled shaft report by the geotechnical testing firm for each drilled shaft, recording actual elevation at bottom and top, elevation of bedrock (if any), final centerline location at top, variation of shaft from plumb, results of tests performed, actual allowable bearing capacity of bottom, depth of bedrock socket (if applicable), levelness of bottom, specifics of drilling fluid used (if any), seepage of water, still water level (if allowed to flood), elevation of bottom and top of any casing left in place, any unusual conditions, and dates of starting excavation, completion of excavation, inspection, testing, and placement of concrete (include any delays in concreting and location of construction joints in shafts).

E. **Submittal Package No. 5 – Concrete Test Report**

1. Submit concrete test reports, recording pertinent information and certification of compliance with project requirements within 24 hours after tests directly from the concrete testing laboratory.

1.5 JOB CONDITIONS

A. **Existing Utilities**. Locate existing underground utilities in area of work before starting drilled shaft excavation operations. If utilities are to remain in place, provide adequate means of support and protection during construction operations.

B. **Unforeseen Utility Location**. Should a utility which is encountered during excavation be unrecorded or recorded incorrectly, consult the utility immediately for directions. Cooperate with the utility or Owner in keeping respective services or facilities in operation. Repairs shall be made to damaged utilities to the satisfaction of the utility owner.

C. **Interruption**. Do not interrupt existing utilities serving functions used by Owner or others except when permitted in writing by the Engineer. Provide acceptable temporary utility services unless the Owner agrees to discontinue the utility for a defined period of time.

D. **Notification**. Provide a minimum of 48 hours' notice to utility company and Owner or Engineer and written notice to proceed before interrupting any utility.

E. **Protection**. Protect existing structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout, and other hazards created by construction operations.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Steel Casings**.

1. Deliver steel casings to the site in an undamaged condition and handled in a manner to prevent damage.
2. The lengths of the steel casings shall be as necessary to construct the drilled shafts.
3. The diameter of the casings shall be large enough to allow the construction of the drilled shaft with a diameter equal to or greater than the plan diameter.

B. **Reinforcing Steel**.

1. Deliver reinforcing steel to the site in an undamaged condition and handle in a manner to prevent damage.
2. Store the reinforcing steel on wood blocking above ground to prevent contamination from mud and other deleterious substances.
3. Remove all mud and deleterious substances from the reinforcing steel prior to placing the steel cage of reinforcement in the drilled shaft excavation.

1.7 **SPECIAL WARRANTY.** (Not used)

PART 2 - PRODUCTS

2.1 **CONCRETE AND RELATED MATERIALS**

A. **Concrete**. Concrete work shall conform to all requirements of ACI 301-99, "Specifications for Structural Concrete for Buildings," except as modified by the supplemental requirements below.

B. **For Concrete Not Placed Under Water**

1. The concrete shall have a 28-day compressive strength of 4,000 pounds per square inch (psi).
2. The maximum water-to-cementitious-material ratio shall not exceed 0.40.
3. For concrete exposed to the weather in the completed structure, the entrained air shall be between 5 percent and 7 percent.
4. The concrete shall contain Type F or G high-range water reducer (HRWR) (ASTM C 494).
5. The maximum size coarse aggregate shall be No. 57 size (American Association of State Highway and Transportation Officials [AASHTO] M43).

6. The concrete slump at the point of placement shall be between 5 inches and 7 inches.

C. **For Concrete Placed Under Water**

1. The concrete shall have a 28-day compressive strength of 4,000 psi.
2. The cement content shall not be less than 600 pounds per cubic yard of concrete.
3. The maximum water-to cementitious-material ratio shall not exceed 0.40.
4. The concrete shall contain 40 pounds of silica fume (ASTM C 1240) per cubic yard of concrete.
5. The concrete shall contain 80 pounds of Type F fly ash (ASTM C 618) per cubic yard of concrete.
6. The concrete shall contain HRWR of a type and in the amount recommended by the antiwashout admixture (AWA) manufacturer.
7. The concrete shall contain AWA. The AWA shall be added at the rate recommended by the manufacturer to prevent washout as defined below.
8. AWA shall be Eucon AWA by Euclid Chemical Co., Rheomac UW 450 by Master Builders Technologies, Sikament 100 SC by Sika Corp., or approved equal.
9. For concrete exposed to weather in the completed structure, the entrained air shall be between 4 percent and 6 percent.
10. The maximum size coarse aggregate shall be No. 57 size (AASHTO M43).
11. The concrete slump at the point of placement shall be between 6 inches and 8 inches.
12. Concrete shall be cohesive so as not to washout and shall be flowable so as not to leave voids. The weight loss after three standard test drops in water (per Corps of Engineers CRD C61) shall not exceed 6 percent.

D. **Reinforcing Steel**. Reinforcing steel shall be Grade 60.

E. **Spacers**.

1. Use concrete spacers or other approved noncorrosive spacing devices at sufficient intervals (near the bottom and at intervals not exceeding 10 feet) to ensure concentric spacing for the entire cage length.
2. Construct spacers of approved material equal in quality and durability to the concrete specified for the drilled shaft.
3. The spacers shall have adequate dimensions to ensure the proper annular space between the outside of the reinforcing cage and the side of the excavated hole.
4. Provide cylindrical concrete feet (bottom supports) to ensure that the bottom of the cage is maintained the proper distance above the base.

2.2 STEEL CASING

A. **General**. The casing shall be made of steel, shall be watertight, and shall be of ample strength to withstand handling stresses and external subsurface pressures

from soil and water or internal pressures from concrete. The casing shall be free of deleterious substances adhering to the inside of the casing.

B. **Steel Casings**. ASTM A 252 - Grade 2, ASTM A 283 - Grade C, or ASTM A 36.

C. **Corrugated Steel Casings**. ASTM A 444.

PART 3 - EXECUTION

3.1 DRILLED SHAFT INSTALLATION

A. **Preparation**.

1. Install drilled shafts after the foundation excavation is complete.
2. Drilled shafts shall be plumb.
3. The drilled shaft installation techniques used shall have no negative impacts on surrounding structures, pavements, or utilities, and shall not result in the development of voids or ground collapse around the perimeter of the drilled shafts.

B. **Sequence of Installation**. For closely spaced drilled shafts and those occurring in weak soil conditions, the installation sequence shall be such that no drilled shaft is installed adjacent to either an open drilled shaft excavation or a concreted drilled shaft where the concrete has less than a 7 day cure. When a test load is required, install only the test and reaction shafts until the test loading is complete and the results have been determined.

C. **Casing Installation**.

1. Provide a steel casing for the construction of each drilled shaft.
2. Consider all casings temporary unless specifically shown as permanent casing.
3. Remove temporary casings before completion of the concreting of the drilled shafts.
4. Install casings as excavation proceeds or prior to excavation so that excavation walls are maintained without caving into the drilled shaft excavation.
5. In granular soils, soft weak caving soils, or excavations adjacent to structures, advancing the auger ahead of the casing (including "processing the hole") is not permitted unless acceptable to the Engineer.
6. Advance casing by a suitable means prior to excavation of material inside casing. This may include use of a vibratory hammer if appropriate.
7. Where casings are extended to bedrock, seat them into the bedrock in an attempt to seal out incoming water.
8. When permanent casings are used, pressure-grout any voids that develop between the shaft excavation and casing with cement grout at no additional cost to the Owner.
9. Perform pressure grouting after the concrete for the drilled shaft has been placed. Submit the method of pressure-grouting the voids for review and comment.

D. **Excavation**

1. Excavate drilled shafts to the required bearing strata or elevations shown.

2. If indicated depth of shaft excavation is reached without developing required stratum bearing capacity, as determined by the geotechnical testing firm, immediately suspend excavation operations and inform Engineer. Engineer will determine procedures to be followed.
3. Drilled shaft dimensions shown are minimums. The design of the drilled shafts is based on assumed strata bearing capacity.
4. If bearing stratum is not capable of providing bearing capacity assumed, revise foundation system as directed. Revisions will be paid for in accordance with Contract conditions relative to changes in work.
5. The work of this section includes the removal of soil, cobbles, boulders, and bedrock. Remove other subsurface obstructions which are indicated by the Contract Documents.
6. If obstructions are encountered, such as concrete, old foundations, or bedrock, which are not indicated by the Contract Documents and which cannot be removed by standard drilled shaft excavation methods, these obstructions shall be paid for in accordance with the terms of the Contract conditions relative to changes in work.
7. Make a sufficient attempt to free the obstruction, such as spudding, ramming, and churning, before resorting to any compensated obstruction removal techniques. Begin no compensated obstruction removal technique prior to notifying the Engineer of the conditions encountered.
8. No blasting will be permitted without approval.
9. Where shown, bedrock socketed drilled shafts shall penetrate into bedrock to a minimum depth shown.
10. Clean the bottom of the drilled shafts from drilling spoils. Remove drilling spoils that adhere to the vertical sides of the bedrock sockets. Hand excavation and cleaning may be required.
11. No payment will be made for extra length, when drilled shafts are excavated to a greater depth than required or authorized due to overdrilling. Overexcavated shafts will be measured and paid for to original design or authorized depth. Complete drilled shaft and fill extra depth with specified concrete if other conditions are satisfactory.
12. Remove excavated material and legally dispose of waste off-site or on-site if permitted by the Contract Documents or permitted by the Engineer.

E. **Construction Tolerances**.

1. Locate centerline of drilled shafts within the following tolerances:

    a. Maximum permissible variation of location not more than 1/24 of drilled shaft diameter or 3 inches, whichever is less.
    b. Drilled shafts out of plumb shall not exceed 1.5 percent of length nor 12.5 percent of shaft diameter, whichever is less.
    c. Concrete cut off elevation, +1 inch to -3 inches from plan elevation.

2. If above tolerances are exceeded, the drilled shaft is considered defective.

3. Provide corrective construction to compensate for excessive eccentricity and location at no cost to the Owner. Submit proposed corrective construction methods for review before proceeding.

4. If the excavated shaft of a defective drilled shaft is abandoned, the hole remaining in the ground shall be filled with concrete or a material acceptable to the Engineer at no cost to the Owner.

F. **Dewatering**.

1. Make a reasonable attempt to seal water out of the drilled shaft excavation and control any incoming water with pumps, sumps, or other dewatering equipment to the extent that the drilled shaft excavation is maintained dry enough for the performance of the required inspection and concrete placement operation.
2. If groundwater or soil conditions are such that dewatering inside the drilled shaft excavation may disturb the bearing strata or if a reasonable attempt utilizing a casing to seal out the incoming water has been made and failed, then dewatering the excavation inside the casing will not be required.
3. Ensure that the water or drilling fluid elevation inside the casing is at all times, either during or after excavation, equal to or higher than the static water elevation immediately outside the casing.
4. Use work methods that prevent water from flowing into the casing through the bottom of the casing.
5. Direct water to general site runoff ditches and disposal areas with discharge lines. Provide ditching as required to direct water to site drainage facilities.

G. **Reinforcing Placement**. Completely assemble the reinforcing steel cage prior to placement in the drilled shaft excavation. The reinforcing steel cage length shall be as necessary for the actual depth of the shaft based on conditions encountered.

H. **Provisions for Inspection and Testing**.

1. Have at the job site all equipment and materials needed to provide safe inspection and testing of the drilled shafts as required by city, state, and federal safety requirements.
2. Provide and maintain suitable means for access and safe descent into all drilled shaft excavations.
3. Provide access by a positive forward and reverse hydraulic winch or power-up and power-down hoist on a crane.
4. The method chosen for entering or leaving the shaft shall be convenient, safe, and not uncomfortable for the user.
5. Provide continuous surveillance of all persons in the drilled shaft excavations and provide lighting powerful enough for performance of the inspection.

6. At all times when a person is in the drilled shaft excavation, provisions shall be made for pumping fresh air to said person.
7. All lighting shall be with electrical lights.
8. Mechanical equipment used inside the shafts shall be operated by air or electricity.
9. Do not use gasoline engines or other types of equipment producing fumes that may enter the excavation.
10. Provide gas detection and oxygen analyzers, and shall test the drilled shaft excavation atmosphere qualitatively throughout the column's entire length and ensure that the quantities of gases and oxygen present are in safe amount and safe proportion prior to permitting any person to enter the shaft.
11. When inspections and testing are made from the ground surface by means which require the testing agency to work over the center of the drilled shaft excavation, construct a suitable work platform at the ground surface over the top of the drilled shaft excavation.

I. **Protection**. Adequately cover the tops of all drilled shafts until concrete is placed. Prevent surface water from flowing into shaft excavation.

3.2 CONCRETE PLACEMENT

A. General.

1. Place concrete in-the-dry unless placing under water is acceptable.
2. Place the concrete for the drilled shafts immediately after inspection and approval by the geotechnical testing firm and reinforcing placement.
3. Concrete placement shall be continuous from the bottom to the top elevation of the drilled shaft.
4. Concrete placement shall continue after the drilled shaft excavation is full until good quality concrete is evident at the top of the drilled shaft and all laitance is removed.
5. Remove excess concrete to cutoff elevation shown, screed level, and apply a scoured, rough finish.
6. Where cutoff elevation is above ground elevation, form top section above grade and extend shaft to required elevation.
7. Provide mechanical vibration for consolidation of the top 5 feet of each shaft.

B. Free Fall Placement.

1. The concrete can be placed by the free fall method only if the excavation is dry.
2. The maximum height of the free fall placement shall not exceed 25 feet.
3. Use drop chutes or tremies for placing concrete where a drop of more than 25 feet is required, or pump concrete into place.
4. Concrete placed by the free fall method shall drop through a centering chute and fall directly to its final position through air without striking the sides of the hole, the reinforcing steel cage, tie wires, or any other obstructions.

C. **Concrete Placed Under Water**.

1. If concrete placement in-the-dry is not possible or reasonable attempts to seal off water flow have failed, concrete may be placed by the tremie method or other acceptable methods of depositing concrete under water.
2. After the concrete reaches the top of the forms, place additional concrete to displace diluted concrete from the top of the lift.
3. Place concrete conforming to Chapter 8, "Concrete Placed Under Water," of ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," except as modified herein.
4. A copy of this chapter shall be on-site during the work.

D. **Casing Removal**.

1. If the casings for the drilled shafts are to be removed, do not vibrate the concrete until the casing is completely removed and the drilled shaft top is formed to the plan cross section.
2. Take care when removing the casing so that the reinforcing steel cage is not deformed or displaced by the force of the downward flowing concrete.
3. Maintain adequate head of concrete above the casing bottom to prevent reduction in the diameter of the drilled shaft or contamination of the concrete from surrounding earth and water pressures including any fluid trapped behind the casing.
4. Remove casings while the concrete is still in a plastic state (before concrete attains initial set).
5. Temporary casings that are required to be completely or partially removed which become bound or fouled during drilled shaft construction and cannot be practically removed shall constitute a defective drilled shaft.
6. Improve such defective shafts to the satisfaction of the Engineer.
7. Such improvements may consist of but are not limited to removing the shaft concrete and extending the shaft deeper to compensate for the loss of frictional capacity in the cased zone, providing straddle shafts to compensate for capacity loss or providing a replacement shaft.

3.3 FIELD QUALITY CONTROL

A. **General**.

1. Each drilled shaft shall be continuously monitored by the geotechnical testing firm during drilling.
2. Each drilled shaft shall be inspected and tested by the geotechnical testing firm immediately before placing concrete.
3. Cooperate with the inspecting and testing personnel to expedite the work.
4. Notify the Engineer at least 2 hours prior to the time the drilled shaft excavation will be ready for inspection and testing.

B. **Geotechnical Testing Firm**.

1. The geotechnical testing firm shall perform the following specified tests and inspections and any additional tests and inspections required to ensure proper construction of the drilled shafts.

2. Conduct tests and provide reports as soon as possible to not delay concrete placement operations for acceptable drilled shaft excavations.

3. Bottom elevations, bearing capacities, and lengths of drilled shafts as shown are estimated from available soil data.

4. Actual elevations and drilled shaft lengths and bearing capacities will be determined by geotechnical testing firm from conditions found in excavations.

5. Final evaluations and acceptance of data will be determined by Engineer.

    a. Verify and record bottom elevations, diameters, lengths, alignment, elevations, and any other appropriate dimensions or conditions necessary to accurately document the construction of the drilled shafts.

    b. Determine and record the actual allowable end bearing capacity of each drilled shaft. For each drilled shaft conduct the following tests:

        1) For drilled shafts bearing on soil, perform unconfined compression tests, standard penetration tests, or other acceptable methods to obtain the actual allowable end bearing capacity of each drilled shaft.
        2) For drilled shafts bearing on bedrock, perform unconfined compression tests, soundings and probes, or other acceptable methods to obtain the actual allowable end bearing capacity of each drilled shaft.

C. **Concrete Testing Service**. The concrete testing service shall perform the concrete tests specified in ACI 301 Chapter 16 and as modified by the supplemental requirements below:

1. Compressive Strength Tests. ASTM C 39; one set of four cylinders per drilled shaft but not more than one set per truck. One specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
2. Slump. Determine slump of concrete for each truckload of concrete delivered and of concrete sample collected for compressive strength test.

D. **Additional Tests**. The following additional tests may be required at the Contractor's expense when requested by the Engineer.

1. Concrete testing service shall take core samples of in-place concrete when test results indicate that there is reasonable doubt that specified concrete strengths have not been attained.

2. Continuous coring of drilled shafts may be required when time for removal of temporary casings exceeds specified limits, or where observations of placement operations indicate suspicion of quality of concrete, presence of voids, segregation, or other possible defects.

3.4 **MEASUREMENT.** The total length of drilled shafts shall be the sum of the lengths in feet of all completed and accepted drilled shafts measured along their axis from the bottom of the drilled shaft to the cutoff elevation.

END OF SECTION

SECTION 32 10 01.01

PAVEMENT AND WALKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, tools, equipment, and materials necessary to construct the driveways, parking areas, and walks in accordance with plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all applicable federal, state, and local codes and regulatory agencies.

B. **Standards**. Material and work shall be in conformance with:

1. ODOT - Ohio Department of Transportation.

C. **Testing Laboratory.** Engage a testing laboratory acceptable to the Engineer/Architect to perform subgrade inspection and compaction tests.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's data on all material.

B. **Certification**. Submit in writing certification that all materials and mixes are in conformance with ODOT specifications.

C. **Test Data**. Submit test data as required under paragraph 3.2 B.1.

1.5 JOB CONDITIONS

A. **Coordination**

1. Coordinate all pavement installation with proper authorities.
2. Coordinate pavement installation with other work of contract such that there is minimum disruption of the completed pavement and/or delays of other work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Comply with ODOT Item 401.11 hauling requirements.

B. **Storage**. Comply with ODOT Item 106.05.

C. **Handling**. Comply with ODOT Item 106.06.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIAL**

A. **General**. All material shall be in accordance with ODOT "Construction and Material Specifications."

B. **Bases**

1. Aggregate. Aggregate base shall be in accordance with ODOT Item 304. The use of slag is not permitted.
2. Asphalt Concrete. Asphalt concrete base shall meet the specifications of ODOT Item 301.

C. **Prime Coat**. Prime coat shall be in accordance with ODOT Item 408. Materials shall conform to the applicable requirements of 702 for the asphalt material and use one of the following types: 702.02 Rc-70, RC-250, MC-30, MC-70, or MC-250; or 702.03 Primer 20.

D. **Tack Coat**. Tack coat shall be in accordance with ODOT Item 407. Materials shall conform to the applicable requirements of 702 for the asphalt material and use one of the following types: 702.04 RS-1, SS-1, SS-1h, CRS-1, CSS-1, CSS-1h; or 702.13.

E. **Asphalt Concrete**

1. Surface Course. Asphalt concrete surface course shall be in accordance with ODOT Items 441, 446, and/or 448 and as indicated on the plans. The surface course type shall be as indicated on the plans.
2. Intermediate Course. Asphalt concrete intermediate course shall be in accordance with ODOT Items 441, 446, and/or 448 and as indicated on the plans. The intermediate course type shall be as indicated on the plans.

F. **Concrete with Portland Cement**. Concrete shall be in accordance with Section 03 30 00, "Cast-in-Place Concrete," Class A or ODOT Item 452.

G. **Expansion Joint**. Expansion joints shall be 1/2-inch-thick premolded, nonextruding type.

H. **Parking Blocks**. Parking blocks shall be precast concrete, standard curb type, 6" x 8" x 8’ with tapered edges and predrilled for anchoring. Provide three 3/4" x 16" hot-dip galvanized steel anchor pins per unit.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. **Verification of Conditions**. Verify that subgrade is at proper elevation and slope where required. Verify that the subgrade is free of moisture which will interfere with attainment of compaction required.

3.2 PREPARATION

A. **Topsoil**. Topsoil shall be removed. See Section 32 90 02, "Grading and Seeding."

B. **Subgrade**

1. Compaction. See Sections 31 23 34, "Excavation and Backfill," and 31 24 00, "Embankments."
2. Foreign Material. All loose and foreign materials shall be removed and the subgrade shall be free of ruts and standing water when the base material is placed.

C. **Slope**. Driveways, parking areas, and walks shall be sloped to drain away from buildings and structures. Driveways in open areas shall have a center crown. Cross slope for driveways and walks shall be 1/4 inch per foot unless otherwise shown.

D. **Existing Pavement**. Driveways, parking areas, and walks shall conform to the grade of existing pavements or walks unless modifications are shown on the plans or required by the specification. Where it is necessary to disturb existing Portland cement concrete pavements or walks, the concrete shall be saw-cut in neat, straight lines. The depth of saw cut shall be at least 2 inches. Where it is necessary to disturb existing asphalt concrete pavements or walks, the asphalt concrete shall be line cut with straight vertical edges by saw cutting. All cut bituminous surfaces shall be sealed with a bituminous material.

E. **Arrange for inspection** and testing as work progresses.

3.3 PAVEMENT

A. **General**. All construction shall be in accordance with ODOT "Construction and Material Specifications."

B. **Asphalt Concrete Driveways and Parking Areas**

1. Aggregate Base. Aggregate base shall consist of compacted aggregate applied in layers of equal thickness to a depth shown on the plans in accordance with Item 304.04. Maximum lift thickness shall be 8 inches when vibratory rollers greater than 12 tons are used, 6 inches when vibratory rollers between 10 and 12 tons are used, and 4 inches when vibratory rollers are not used. Compaction shall be in accordance with ODOT Item 304.05.
2. Prime Coat. Prime coat shall be applied according to ODOT Item 408 at the rate of 0.40 gallon per square yard.
3. Asphalt concrete base shall be installed in two layers each 3 inches thick after compaction.
4. Wearing Surface. Unless otherwise shown, wearing surface shall consist of at least 3 inches of asphalt concrete applied in two layers. The surface

course shall be 1-1/2 inches thick after compaction. The intermediate course shall be 1-3/4 inches thick after compaction.

4. Asphalt concrete base and asphalt pavement shall be installed in accordance with ODOT Items 301, 441, 443 surface course, and 448 intermediate course. The surface course type and intermediate course type shall be as indicated on the plans.

C. **Gravel Driveways and Parking Areas**. Gravel driveways and parking areas shall consist of a 10-inch course of compacted aggregate base applied in two layers, each 5-inches thick after compaction. Placement shall be in accordance with ODOT Item 304.04. Compaction shall be in accordance with ODOT Item 304.05.

D. **Resurfacing**

1. Surface Preparation. No material shall be placed until the existing surface areas have been examined and all holes, broken edges, cracks, and damaged areas have been repaired.
2. Tack Coat. Tack coat shall be applied according to ODOT Item 407 at the rate of 0.15 gallon per square yard.
3. Wearing Surfaces. Existing areas shown on the plans shall be resurfaced with an asphalt concrete meeting ODOT Item 448 and applied to a minimum thickness of 1 1/2 inches after compaction.

3.4 ASPHALT WALKS

A. **Asphalt Concrete Walks.** Asphalt concrete walks shall be constructed as specified for asphalt concrete driveways and parking areas, except aggregate base shall be 4 inches thick and the wearing surface meeting ODOT Item 441 shall be a minimum of 2 inches thick.

3.5 CONCRETE WALKS

A. **Concrete Walks.** Concrete walks shall be 4 inches thick, except on driveways which will be 6 inches set on a 4-inch compacted aggregate base.

B. **Finish**. Concrete shall be float finished with a tooled joint every 4 feet and an expansion joint every 20 feet.

3.6 FIELD QUALITY CONTROL

A. **Spreading and Surface Tolerances**. The variation of the aggregate surface shall be in accordance with ODOT 301, 304, and 401 after compaction.

B. **Compaction**. In addition to requirements of ODOT 301, 304, 401, and 441, the aggregate and pavement shall be tested by proofrolling with vehicle loads equal to or exceeding 80,000 pounds per four axles or 20,000 pounds per single axle.

C. **Tolerance of Completed Surface**. The variation of the completed surface courses shall not exceed the requirements of ODOT 401.16.

END OF SECTION

SECTION 32 31 13

CHAIN-LINK FENCES AND GATES

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK.** Provide the labor, tools, equipment, and materials necessary to construct the chain-link fence and gates in accordance with the drawings and the specifications.

1.3 **QUALITY ASSURANCE**

A. **Standards**. Conform materials and workmanship with the following standards referenced herein:

1. ASTM - American Society for Testing and Materials.

B. **Source**. Provide chain-link fence and gates as complete units controlled by a single source including necessary erection accessories, fittings, and fasteners.

C. Test related fence construction materials for posts and rails shall me ASTM F1043 for Heavy Industrial.

1.4 **SUBMITTALS.** Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Product Data. Manufacturer's specifications and published data including all information required to substantiate that materials comply with the specifications.

2. Shop Drawings showing size, gauge, weight, and finish of all materials, method of anchorage, gate details, hardware, and plan layout. Include a list of materials and product warranty.

3. Warranty. Written warranty called for in paragraph 1.7 of this section.

4. Samples.

a. A 1-foot-square section of fence fabric.
b. A 1-foot-long section of post and rail.
c. A 1-foot-long sample of the barbed wire.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING.** In accordance with Section 01 60 00, "Materials and Equipment."

1.7 **SPECIAL WARRANTY.** The manufacturer shall provide a 15-year warranty against rust and corrosion of the fence.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fabric

1. The fence fabric shall be galvanized steel wire, 2-inch mesh chain-link.
    a. 6 feet high and over shall have the selvage edges twisted and barbed on both top and bottom.
2. Wire.
    a. Commercial quality
    b. Medium high carbon 9 gauge steel wire
    c. Hot dipped galvanized
    d. Minimum tensile strength of 100,000 pounds per square inch (psi).
3. Galvanizing. After fabrication, hot-dip-galvanize fabric in accordance with ASTM A 392.

B. Framing

1. Galvanizing.
    a. All steel framing parts inside and outside.
    b. In accordance with ASTM F 1083.
    c. Minimum of 1.8 ounces per square foot of the total coated surface.
2. Post and rail specific requirements. Dimensions listed are inside diameters.
    a. Top Rail.
        1) 1-5/8-inch Schedule 40 at 2.27 pounds per foot or SS-40 at 1.83 pounds per foot.
        2) Provide means of attaching securely to each gate, cover, and post and adjacent line post.
    b. Bottom Rail. 1-5/8-inch Schedule 40 at 2.27 pounds per foot or SS-40 at 1.83 pounds per foot.
    c. Tension Wire. 6-gauge, galvanized, high-carbon steel coil spring wire.

d. Line Posts.

1) ASTM F1083: 2-1/2 NPS, Schedule 40.
2) ASTM A1011: 2-1/2 NPS, Schedule 40. Hot-dip galvanized, ASTM B6 zinc, 1.0 OZ/SQFT per ASTM A90. Chromate coating over zinc, 30 micrograms/SQIN.

e. Terminal and Straining Posts.

1) ASTM F1083: 4 NPS, Schedule 40.
2) ASTM A1011: NPS 4, 6.56 LB/FT. Hot-dip galvanized, ASTM B6 zinc, 1.0 OZ/SQFT per ASTM A90. Chromate coating over zinc, 30 micrograms/SQIN.

f. Gate Posts. Size gate posts to meet the following:

Gate Width	Gate Post Minimum Requirements
Up to 6 feet wide	3-inch Schedule 40 at 5.79 pounds per foot
6 feet to 13 feet wide	4-inch Schedule 40 at 9.11 pounds per foot
13 feet to 18 feet wide	6-5/8-inch Schedule 40 at 19.92 pounds per foot
Over 18 feet wide	8-inch Schedule 40 at 24.70 pounds per foot

g. Post Brace. 1-1/4 NPS, Schedule 40 per ASTM F1083.

h. Truss Rod. 1/2-inch steel rod complete with turnbuckle.

i. Gate Frames. 2-inch Schedule 40 at 2.72 pounds per foot or SS-40 at 2.281 pounds per foot, adequately braced, with all corners electrically welded. Single cantilever gates shall comply with ASTM F1184.

C. **Barbed Wire**. Fit fence posts and gates with galvanized barbed wire arms for carrying three strands of barbed wire at a 45-degree angle. Barbed wire shall be maximum-security type of two-strand 12-gauge wires with four-point aluminum barbs, 5 inches apart. Barbed wire shall be four-point barbs and be class 3 zinc coating per ASTM A121.

D. **Hardware**

1. Fence shall come complete with all necessary hardware, fittings, and accessories such as tension bars, tension bands, brace bands, end clamps, gate post caps, nuts, and bolts. Fence fittings shall comply with ASTM F626.

2. Gate hardware shall consist of bottom corner pivot hinge, upper hinge, latch fork with lock keeper and guide, fork catch, stop and hold open, and plunger bar and catch for double leaf units.
3. Galvanize all hardware.

E. **Concrete**. Concrete for setting posts in the ground shall be Design Mix Class A in accordance with Section 03 33 00, "Cast-in-Place Concrete."

F. **Electric Slide Gate**

1. Slide gate shall have a variable speed, 1/2hp, 115v, single phase operator with a weather-resistant galvanized steel cabinet with a lockable, gasketed, hinged and removable front cover for access. Operator shall include two detectors (free exit/reverser), surge protector, heater, and contact edge with transmitter and receiver. Slide gate operator shall be Linear/Osco model VS-GSLG, or equal.
2. Slide gate operator control shall be an exterior digital keypad programmable with up to 480, 1 to 6-digit length entry codes. The encloser shall be rugged, AST aluminum for pedestal mounting. Controller shall be Linear model AK-1, or equal.

PART 3 – EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**

1. Verify that site conditions are satisfactory for a successful fence installation.
2. Correct any unsatisfactory conditions before installation.
3. Notify Engineer/Architect of any conditions that cannot be corrected.
4. Confirm final locations and property lines.

3.2 **PREPARATION.** Perform clearing and grubbing to construct the fence to the required alignment. Grade to provide a reasonably smooth ground profile at the fence line.

3.3 INSTALLATION

A. Install fence in accordance with ASTM F567 and as shown on Contract Drawings.

B. **Posts**

1. Ground Installation. Place posts at least 34 inches below finished grade. Encase posts in concrete a minimum of 36 inches below finished grade with 6 inches around the post and a 1-inch crown.
2. Concrete Installation. Place posts in concrete slabs, walls, or floors in preformed holes, minimum 8 inches deep with the inside diameter 1 inch greater than the outside diameter of the post. Fill the annular space with nonshrink grout and crown to 1 inch at post.
3. Spacing. Install line posts at maximum 10-foot centers.

4. Install all posts vertically straight.

C. **Fabric**

1. Erect the fabric a minimum of 7 days after setting the posts in concrete.
2. Fasten the fabric to the line posts with clips or bands spaced at approximately 14 inches apart and to the top and bottom rails with bands or tie wires at approximately 24- inch intervals.
3. Fasten the fabric to terminal posts using a tension bar with tension bands spaced 12 inches apart.
4. Fabric shall be rigid and taut.

D. **Horizontal Deflection**. At points of deflection where the fence changes alignment by more than 5 degrees, provide a post brace and truss rod in each fence panel adjacent to the post located at the angle point.

E. **Post Braces**. Support each gate, straining, and terminal post with a post brace and truss rod. Extend the brace from the line post back to the gate, straining, or terminal post.

F. **Bottom Rail or Tension Wire**. When a bottom rail is not shown, reinforce the bottom of the fabric by a tension wire stretched through the fabric and tied to the posts with the fabric.

G. **Gates**.

1. Gates shall be same height and fabric as the fence and capable of 180 degree swing.
2. All gates shall be plumb, level, and secure.
3. Adjust all hardware for smooth operation.

H. **Barbed Wire**. Pull and anchor three strands of barbed wire to the arms. Alternate location of barbs in each strand a maximum of 2-1/2 inches on center in alternate layers.

3.4 DEMONSTRATION

A. **Visual**. Verify that all fencing has been installed in accordance with the Contract Documents by walking the entire fence line and showing the Owner and/or Engineer/Architect that:

1. All corner and gate posts are braced.
2. All posts are set in concrete with 1-inch crown.
3. Fabric is tight and properly anchored.
4. All gates operate freely and latch and unlatch easily.

PART 4 SCHEDULE

4.1 FENCE AND GATE SCHEDULE

A. Sugar Creek Wellfeild

1. 1130 LF Demo existing fence
2. 1130 LF New Fence
3. 0 – 30’ Manual Cantilever Gate
4. 7 – 16’ Double Swing Gate

B. **Sugar Creek Water Treatment Plant**

1. 600 LF Demo existing fence
2. 600 LF New Fence
3. 1 – 30’ Automatic Cantilever Gate
4. 2 – 16’ Double Swing Gates

The new fence lengths provided in the schedule of this section **does not** include the length of the gates.

END OF SECTION

SECTION 32 90 02

GRADING AND SEEDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the grading and seeding as shown and specified herein.

1.3 QUALITY ASSURANCE

A. **Certificate of Inspection**

1. Ship all seeds with a certificate of inspection in accordance with the governing authorities.
2. Label all bags of seed and fertilizer with legible waterproof tags or directly on the bag.

1.4 SUBMITTALS

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and this specification section.

B. **Submittal Package No. 1 – Product Data and Certified Statement**

1. Submit seed vendor's certified statement for each grass seed mixture required that includes:

   a. Botanical and common name.
   b. Percentage by weight.
   c. Percentages of purity, germination, and weed seed for each grass seed species.

2. Product Data. Submit information on all materials included in this specification.

1.5 JOB CONDITIONS

A. **General**. Proceed with grading and seeding as soon as portions of the site become available, working within seasonal limitations and the seed manufacturer's recommended limitations regarding weather conditions and temperatures.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**

1. Deliver seed only when site conditions are ready.
2. Deliver materials in unopened containers showing weight, mixture analysis, package date, and manufacturer.

B. **Storage and Handling**

1. Store and cover material to prevent wetting and deterioration.
2. Remove packages from the site that have become wet, moldy, or damaged, or show water marks.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIAL**

A. **Topsoil**. Topsoil shall contain:

1. A maximum of 40 percent clay in that portion passing a No. 10 sieve.
2. Between 5 and 20 percent organic matter as determined by loss on ignition of samples oven-dried at 212 degrees Fahrenheit (^{o} F.) to a constant weight.

B. **Fertilizer**. Fertilizer shall contain the specified percentages of total nitrogen, available phosphoric acid, and water soluble potash. The weight, name of plant nutrients, and guaranteed percentages shall be marked on the sealed fertilizer containers.

1. 12-12-12. This fertilizer shall be used with Seed Mixes 1, 2, 3, and 5.
2. 5-10-10. This fertilizer shall be used with Seed Mix 4 (Crownvetch).

C. **Inoculant**. Treat Seed Mix 4 (Crownvetch) with inoculant culture of nitrogen fixing bacteria less than 1 year old.

D. **Seed**. Percentages are by weight.

	Minimum Germination	**Minimum Purity**
1. Seed Mix 1		
40% Kentucky Bluegrass (*Pos pratensis*)	75%	85%
40% Creeping Red Fescue (*Festuca rubra*)	85%	98%
20% Annual Ryegrass (*Lolium multiflorum*)	85%	95%

		Minimum Germination	Minimum Purity
2.	Seed Mix 2 30% Kentucky Bluegrass (*Pos pratensis*) 50% Kentucky 31 Fescue (*Festucaarundinacea* var. Ky. 31) 20% Annual Ryegrass (*Lolium multiflorum*)	75% 85% 85%	85% 95% 95%
3.	Seed Mix 3 90% Perennial Ryegrass (*Lolium perenne*) 10% Alsike Clover (*Trifolium hybridum*)	85% 85%*	95% 98%
4.	Seed Mix 4 (Crownvetch) 30% Crownvetch (*Coronilla varia*) 30% Kentucky 31 Fescue (*Festuca arundinacea var. Ky. 31*) 30% (Pennlawn) Red Fescue (*Festuca rubra*) 10% Annual Ryegrass (*Lolium multiflorum*)	70%* 85% 85% 85%	99% 95% 98% 95%
5.	Seed Mix 5 80% Kentucky Bluegrass (*Poa pratensis*) 20% Annual Ryegrass (*Lolium multiflorum*)	75% 85%	85% 95%

*Germination includes a total of quick germination plus hard seeds.

E. **Mulch**

1. Straw. Straw mulch shall be baled wheat or oat straw free of weed seed, sticks, or other foreign material.
2. Wood Cellulose Fiber. Dye the wood cellulose fiber mulch green.

F. **Asphalt Emulsion**. Do not use asphalt emulsions.

G. **Mow Strip Blocks**

1. Install concrete mow strips as shown and specified herein. Mow strips shall be precast concrete. Provide two anchor pins for each block. Field-cut blocks to achieve necessary radii.

2. Description.

   a. Height. 6 inches.
   b. Width. 8 inches.
   c. Length. 8 feet.

d. Securing Holes. 7/8-inch diameter.
e. Anchor Pins. No. 6 reinforcement bar, galvanized, 16 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification**. Verify that final grades and elevations have been achieved in all areas. Remove all exposed debris and stones larger than 3/4 inch in any dimension from seeded areas.

3.2 PREPARATION

A. **Soil Tests**. Test soil as necessary to ensure acceptable seeding conditions.

3.3 SEEDING

A. **Seed Mix**. Seed all privately owned lawns with Seed Mix 5. On all privately owned cultivated fields, place the seedbed but do not seed. Seed all other disturbed areas with Seed Mix 1, unless otherwise noted.

B. **Preparation of Seedbed**

1. Remove, stockpile, and use for seedbed topsoil that is available as part of the excavated material.
2. Remove all grass, weeds, roots, sticks, stones, and other debris and finish the seedbed with careful hand raking.
3. If there is a deficiency of topsoil as part of the excavated materials, provide topsoil from another source at no cost to the Owner.
4. The seedbed shall be a minimum of 4 inches of topsoil.
5. Prepare a smooth seedbed before seeding.

C. **Dry Seeding**. When a seed mix is sown dry, apply the materials as follows:

1. Fertilizing.

   a. Apply fertilizer uniformly to all areas to be seeded at the rate of 10 pounds per 1,000 square feet.
   b. Disk, harrow, or rake the fertilizer into the seedbed to a depth of 2 inches.

2. Seeding. Mix thoroughly and sow uniformly the seed over the prepared areas. After sowing, rake, drag, or otherwise treat the area to cover the seed with soil to a depth of 1/4 inch.

   a. Seed Mixes 1, 2, 3, and 5. Sow these seed mixes at a rate of 3 pounds per 1,000 square feet.
   b. Seed Mix 4 (Crownvetch). Sow this seed mix at a rate of 2 pounds per 1,000 square feet. Before sowing, inoculate it in accordance with manufacturer's directions. Sow this seed mix only from November through August.

3. Water. Water the seeded areas at the completion of the sowing and weekly thereafter until accepted by the Owner.

4. Mulching.

   a. Place straw mulching material evenly over all seeded areas within 48 hours of seeding at a rate of 2 tons per acre between March 15 and October 15 and at a rate of 3 tons per acre between October 16 and March 14.
   b. Secure straw mulching material by approved methods.
   c. When mulching is displaced, replace it and reseed the area; repair other work damaged as a result of mulch displacement.

D. **Hydraulic Seeding**

1. When seed is applied hydraulically, use a combined slurry of fertilizer, inoculant when required, seed, and wood cellulose fiber mulch in one operation.
2. Increase the inoculant for Seed Mix 4 (Crownvetch) to five times the manufacturer's recommended rate for dry seeding.
3. Mix wood cellulose fiber at a rate of 1,500 pounds per acre.
4. Mix fertilizer and seed at the rate specified for dry seeding.

3.4 MAINTENANCE

A. **General**. Maintain seeded areas. Fill, grade, and reseed settled and eroded areas. Seeding will not be accepted unless it is alive and healthy.

3.5 DEMONSTRATION

A. **Seeded Area**. Before final acceptance the seeded area shall have:

1. A minimum of 100 grass plants per square foot and less than 2 percent bare spots over the entire area.
2. No individual bare spots larger than 6 square inches

END OF SECTION

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SECTION 33 01 11

TEMPORARY LINE STOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

B. **Excavation and Backfill**. See Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation," for installation requirements.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to install temporary line stops on existing pressurized pre-stressed concrete cylinder pipe (PCCP) mains in accordance with the drawings and as specified herein. The work includes, but is not limited to, the following:

1. Preliminary excavation, inspection, and measurements of existing main scheduled for line stop installation.
2. Interim backfill and temporary paving.
3. Excavation and installation of line stop fitting, testing, and concrete blocking.
4. Shoring and bracing.
5. Installation and testing of temporary line stop.
6. Removal of temporary line stop and installation of completion plug.

1.3 QUALITY ASSURANCE

A. **Manufacturer/Installer**. Work associated with the furnishing, installation, and removal of line stop shall be performed by a contractor experienced in the installation of line stops on large-diameter mains.

B. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

C. **Standards**. Materials and workmanship shall be in conformance with the following standards:

1. AWWA – American Water Works Association.
2. ASTM – American Society for Testing and Materials.
3. ASME – American Society of Mechanical Engineers.

D. **Trench and Excavation Maintenance**. Be responsible for the condition of the trenches and excavations for a minimum period of 1 year from the date of the final acceptance.

1.4 **SUBMITTALS**

A. **Shop Drawings**. Submit shop drawings of the proposed line stop fitting and all accessories.

B. **Procedures**. Submit description of proposed line-stopping procedures.

1.5 **JOB CONDITIONS**

A. **CONTRACTOR** shall coordinate and schedule line stop activities.

1.6 **DELIVERY, STORAGE, AND HANDLING (**Not used.)

1.7 **SPECIAL WARRANTY (**Not used.)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Fittings**. Line stop fittings shall be full encirclement, pressure-retention type split tee consisting of an upper (line stop) flange saddle plate and a lower saddle plate. Upper saddle plate shall include line stop flange and nozzle, and a gasket for sealing against the exterior of the cast iron main to be stopped. Saddle plates shall be constructed of A36 steel plate with a minimum thickness of 0.375 inch. All weldments shall be braced and stress relieved. All steel shall be sandblasted and coated with coal tar epoxy with a minimum dry mil thickness of 0.020 inch. Line stop flanges shall be machined from 150-pound forged steel flange (American Society for Testing and Materials [ASTM] A 181 or A 105) or from pressure-vessel-quality steel plate (ASTM A 285, Grade C), flat-faced and drilled per American National Standards Institute (ANSI) B16.5.

B. **Fasteners**. All bolts, studs, and nuts used on the line stop fitting and appurtenances shall be heavy series.

C. **Plugged Head**. Cylindrical plugging head shall be constructed of a suitable polyurethane compound with a minimum thickness of 4 inches. Bottom of plugging head shall be semicircular to conform to the interior diameter of the main. The bottom of the plugging head shall be designed to break and dislodge tuberculation and other deposits in the main which may interfere with a satisfactory line stop.

2.2 **MANUFACTURERS**

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include Rangeline Pipeline Services, LLC, International Flow Technologies, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. **General**. Refer to Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation," for excavation and backfill requirements.

3.2 EXAMINATION

A. **Verification of Conditions**. Verify the location of required construction. Confirm that conditions are acceptable to begin construction of the work covered in the specification. Complete coordination with other construction or operation activity on the same facility or area.

B. **Preliminary Investigations**. Prior to procuring line stop fittings, expose the water main and perform preliminary measurements on existing pipe at the location of the proposed line stop. Preliminary investigations shall include caliper measurements of the water main outside diameter, and verification of wall thickness and interior condition. Provide any additional information as requested by manufacturer/installer of the line stop. Backfill exposed main.

3.3 OUTAGE

A. **Coordinate work** to minimize outages associated with the installation of the temporary line stop and installation of proposed main, fittings, and valve. Coordinate all work with the Owner. Complete line-cut activity during periods of low water demand, which may include nighttime work.

3.4 INSTALLATION

A. **Line Stop**. Install the line stop fitting including drain nozzle and saddles as required and perform pressure test. Install concrete support and reaction blocking as required. Concrete backing shall be as specified in Section 03 30 00, "Cast-in-Place Concrete." Install line stop machine and insert plugging head into main. Determine adequacy of shutdown as needed to complete proposed cut-ins. Upon completion of proposed work, remove temporary line stop and insert completion plug and blind flange.

END OF SECTION

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SECTION 33 01 33

PIPELINE CLEANING AND CCTV CONFIRMATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to clean the pipeline, manholes and access hatches/manways in accordance with the plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work required to clean the pipelines and manholes in compliance with applicable requirements of governing agencies having jurisdiction.

1.4 SUBMITTALS

A. **Transmittals**. Furnish equipment data and daily logs of work performed.

B. Submit a draft report to Owner for review of findings, recommendations, and proposed cleaning methodology to remove mineral deposits and/or mineral deposits from the initial CCTV Inspection. Once the draft is reviewed and approved by the Owner, Contractor shall finalize and complete cleaning of the pipeline and resubmit a post CCTV Inspection Report summarizing the work performed.

1. The cleaning work submittal shall include a detailed explanation of the cleaning process, proposed access points, and a schedule of activities, references where the Contractor has used the identified cleaning method successfully in the past, and a list of the actions he plans to take to mitigate impact to the public during the cleaning operation.

C. Daily work logs describing the work location (including manhole IDs), work times, labor and equipment used and work progress. The work logs shall include the names of personnel performing cleaning, description of equipment and equipment identification numbers. All transportation manifests, weigh tickets, and disposal receipts from the disposal facility for all material removed from the pipelines and manholes.

D. **Deliverables**. Video/Sonar/Database Sample Submittal(s).

1. The CONTRACTOR may be required to coordinate with the Owner to ensure that submittals are in a compatible format by providing a sample video/sonar/database submittal of all files.

2. Data Downloads/Submittals. The Contractor shall provide the Owner with an electronic copy of the inspection data consisting of CCTV video, sonar video, database files, and inspection reports.

3. Video file shall be provided in MPEG (.mpg) or Windows Media file (.wmv) format. One video file per pipe inspection.

4. Inspection report shall be provided in Adobe Acrobat (.pdf). One report per segment. Report shall include:

   a. Inspection header info (who, what, where, when)

   b. Defect log

   c. Photos of defects

   d. Defect photos: screen captures from the video (.jpg).

5. For large diameter contracts, a maximum of three videos may be submitted for review per asset. Acceptable videos are one pre-cleaning video, one post cleaning video, and a second post cleaning video if a reversal is needed to complete the segment.

1.5 JOB CONDITIONS

A. Contractor shall coordinate and schedule cleaning activities with the Owner to take the existing raw water forcemain out of service. Refer to proposed sequence of construction provided in Division 01

B. Contractor shall assume 4 IN of hard material and/or mineral deposits around the perimeter of the existing raw water forcemain for base bids and confirm after initial inspection.

1.6 DELIVERY, STORAGE, AND HANDLING (Not Used)

1.7 SPECIAL WARRANTY (Not Used)

PART 2 PRODUCTS

2.1 EQUIPMENT

A. **General.** The Contractor shall provide all equipment necessary to clean the pipelines and manholes as described in this specification, and to remove sediment & debris from depths up to 10 feet (approximately). All equipment utilized by the Contractor shall be in good working condition and manufactured or fabricated to withstand the severity of the work covered. If the equipment is found to be defective, it shall be replaced by the Contractor at the Engineer/Owner's request. Contractor will not receive time extensions or change orders due to delays caused by broken equipment and/or not having replacement equipment readily available.

1. All vacuum/pump trucks and combination jet/vacuum/pump trucks shall be equipped with an inspection port or sight glass to observe water levels during cleaning.

2. Contractor shall provide and operate single water jet/nozzle units capable of a minimum of 160 gpm for pipelines that are 20-inch diameter and larger.

3. Contractor shall provide and operate single water jet/nozzle units capable of 80 gpm for pipelines that are smaller than 20-inch diameter.

4. The Contractor shall have available, employ, and have ready on-site, a variety of equipment to clean/break-up/dislodge/cut/remove all materials,

obstructions, and blockages encountered, including but not limited to all items discussed in this specification.

B. **Special Pipe Cleaning Tool.** The Contractor may be required to utilize special cleaning tools in order to clean the pipelines to 95% of the inside pipe diameter being clear and open. Special tools are defined as any type of tool, equipment, head, or attachment which is not of the water jet/nozzle and/or vacuum/pump type system (regardless of size/capacity/configuration). Special tools may include, but not be limited to root cutters; cutting heads; lumberjack; chain cutter; impact auger; porcupine; tap cutter; or grinders. Special tools would also include manned entry required to remove unusually large or heavy materials from the pipe and manhole that cannot be removed by a water jet/nozzle and/or vacuum/pump type system. Contractor shall inform the Owner of the intent to use special tools on a case-by-case basis prior to beginning said work. Dates, times, and durations of use shall be documented in detail.

C. **Sediment & Debris Material.** The term "Sediment & Debris" shall cover and refer to all "materials", regardless of size/shape/weight/material/hardness/ density/chemical composition, encountered inside pipes and are therefore required to be cleaned, dislodged, and removed. The Contractor should anticipate encountering and being able to remove all materials discussed herein, including, but not limited to:

1. Roots. The Contractor shall employ pipeline-cleaning equipment to cut all roots encountered back to the pipe surface. Procedures may include the use of mechanical equipment such as rodding machines, winches with root cutters and high velocity jet cleaners equipped with cutter heads. Chemical means for root removal is prohibited.

   Mineral Deposits, Encrustations, Fats, oils, grease, hard materials, and compacted/solidified materials. The Contractor shall expect to encounter mineral deposits, encrustations, grease buildup, concrete, grout, and other hard densely packed materials. These materials shall be removed to within 1/2-inch or less of the pipe wall. Removal of these materials may require mechanical and/or manual methods and/or specialized pipeline cleaning equipment.

2. Miscellaneous Materials. The Contractor shall expect to encounter miscellaneous materials including, but not limited to: wood, concrete, asphalt, clay, bricks, stones, metal, construction debris, garbage, toys, fire arms, rag balls, rope, automobile parts, bike parts, metal sewer snakes, and any other materials encountered in the pipeline systems. All materials, regardless of size/shape/weight/material/hardness/density/ chemical composition, which are encountered inside the pipeline, whether specifically mentioned or not, are required to be cleaned, dislodged, removed, and disposed as described herein. Materials encountered may be larger than existing manhole openings and therefore will be required to be cut and/or broken up from inside the pipeline in order to be removed.

3. Protruding Laterals. The Contractor shall expect to find some protruding laterals. The Contractor will only address laterals which protrude in length such that cleaning and/or CCTV/sonar equipment cannot pass. These laterals shall be neatly and smoothly removed to within 1-inch or

less of the pipe wall only if the structural integrity of the pipe will not be damaged. A reverse CCTV setup to complete the inspection must be done to the protruding lateral if it cannot be removed.

PART 3 EXECUTION

3.1 DESCRIPTION

A. Clean the pipelines and manholes and access manways/hatches in good workmanlike manner as shown on the Contract Drawings and as specified herein.

B. **General**. Clean the pipeline using hydraulic, high-velocity hydraulic, or mechanical pipe cleaning equipment. Base selection of the equipment used on the condition of the pipe at the time the work commences. The equipment for cleaning shall be capable of removing all foreign materials from the pipeline and manholes.

C. The Contractor shall at all times conduct the work so as to prevent any blockage and surcharging in the pipeline network. The Contractor shall perform all work during periods of weather conducive to their methods and be able to continue work during differing weather and temperature conditions. No interruption to service shall be allowed unless authorized by the Owner. Damage to existing facilities as a result of the Contractor's work shall be promptly repaired in kind at the Contractor's expense at no additional cost to the Owner.

D. The Contractor shall immediately stop work and notify the Owner should any cleaning or inspection yield evidence of, or cause, damage to the existing pipeline. It is the responsibility of the Contractor to select a cleaning method, and conduct operations in a manner, which will not cause damage to different material types and conditions of existing pipelines. The Owner may direct the Contractor to cease cleaning operations should there be evidence that the operation may be damaging to the existing pipeline. At such direction, the Contractor shall perform a post-cleaning television inspection of the pipeline to provide the Owner with video of the internal condition of the pipeline. Such direction by the Owner shall not be cause for additional payment to the Contractor, if the television inspection shows evidence of new damage caused by cleaning operations. If no evidence of new damage caused by cleaning operations is found the television inspection shall be paid. Any damage to existing pipeline due to cleaning operations shall be the responsibility of the Contractor and shall be corrected at the Contractor's expense. Any corrective actions are subject to the approval and acceptance of the Owner.

E. If there is a complaint about overflow in the area served by the reaches being cleaned, the Contractor shall immediately investigate the report and immediately remedy the situation at no additional cost to the Owner. This may include performing any cleanup work necessary or hiring professional cleaning company to assist property owners with cleanup required.

F. Should the Contractor or his employees cause any damage to public or private property, the Contractor will be required to make repairs immediately. The Owner may elect to make repairs or replacements of damaged property and deduct the cost of such from monies due or to become due the Contractor under this contract with the Owner.

G. The Contractor shall take all steps necessary and appropriate to prevent adverse effects on the Water Treatment Plant (WTP) processes during the cleaning work.

If the WTP experiences any reduction in operating efficiency during the execution of the contract, the Contractor shall immediately suspend all applications, at the direction of the Owner. The Contractor shall continue operations only after problems at the WTP have been corrected, satisfactory to the WTP director and superintendent. The Owner reserves the right to suspend or terminate the contract at any time for any reason. The Contractor must maintain contact with Owner on a daily basis.

H. Contractor shall expect to perform manned entry of manholes, access hatches/manways, and pipes in order to deploy and operate inspection and cleaning equipment.

I. If cleaning of the entire pipeline section cannot be successfully performed from one manhole, equipment shall be set up on the opposite manhole and cleaning again attempted. No additional payment shall be made for the reversed set-ups or changes in equipment. If a reverse set-up, cleaning, equipment fails to traverse the entire pipeline section due to a major blockage or defect; the cleaning effort shall be temporarily halted.

J. The Contractor shall determine the location of the major blockage(s) by measuring the length of hose or rod inserted from manholes at each end. Contractor shall immediately report the location of blockage(s) to the Owner.

K. The Contractor shall recognize that there are some conditions such as broken pipes and collapsed pipes that will prevent cleaning from being accomplished or where damage could result if cleaning were attempted or continued. The Owner shall be immediately notified by the Contractor of any and all conditions that warrant termination of the cleaning activities.

L. If the Contractor's cleaning equipment becomes lodged in the pipeline, it shall be removed from the pipeline solely at the Contractor's expense. This shall include excavation and repair of the pipeline, underground utilities, backfilling and surface restoration.

M. Subcontractors proposed by the Contractor to perform this work shall be submitted to the Owner for review and approval.

N. The Contractor shall also be responsible for complying with traffic control regulations and requirements.

3.2 CLEANING

A. Cleaning Methods. The selection of cleaning methods will be at the Contractor's discretion, based on existing pipe and manhole conditions, being able to ensure no damage to existing pipes and manholes or access manways/hatches, the amount and type of debris at the time work commences, and site conditions. The Contractor's selection of cleaning methods shall also consider effectiveness, efficiency, and the ability to meet the project schedule. Pipeline cleaning methods may include, but not be limited to, water jetting, rodding, pigging, bucketing, or manual removal. Flushing the pipe reaches to facilitate cleaning is not permitted. The decision to utilize confined space entry to assist with operations and/or to perform manual cleaning will be the responsibility of the Contractor.

B. Cleaning shall be performed from existing, accessible manholes and access manways/hatches and through same said access points. Materials encountered may be larger than existing manhole openings and will be required to be cut

and/or broken up in order to be removed. Should the Contractor need larger openings to accommodate cleaning equipment and/or sediment & debris material removal, such manhole modifications and replacements shall be submitted to the Owner for review and approval on an individual basis.

C. Where possible, pipeline cleaning shall proceed from upstream pipelines to downstream pipelines, specifically on pipe segments which have service connections. No cleaning shall take place in a particular pipeline segment until the upstream pipe segments (included in the Contract) have been cleaned. If cleaning is done in a downstream pipe segment in order to facilitate overall cleaning operations, the downstream segment shall be re-cleaned or verified to be cleaned at no additional cost, after all pipes upstream of that segment has been cleaned.

3.3 CLEANING EQUIPMENT

A. **Hydraulic**. Hydraulic cleaning equipment shall be of a movable dam type and constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the pipeline. The movable dam shall be equal in diameter to the pipeline being cleaned and shall provide a flexible scraper around the outer periphery to ensure removal of foreign material.

B. **High-Velocity Hydraulic**. High-velocity hydraulic pipeline cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a minimum of 500 feet of 3/4-inch-inside-diameter high-pressure hose with a selection of two or more high-velocity nozzles. The nozzles shall have a minimum capacity of 30 gallons per minute (gpm) at a working pressure of 1,000 to 1,500 pounds per square inch (psi). The nozzles shall be capable of producing a scouring action from 15 degrees to 45 degrees in all size pipelines. Equipment shall also include a high velocity gun for washing and scouring manhole walls and floor. The gun capacity shall be capable of producing flows from a fine spray to a long-distance solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel. All controls shall be located so that the equipment can be operated above ground.

C. **Mechanical**. Bucket machines shall be operated in pairs with power to perform the work. Each machine shall be powered by a minimum 16 horsepower (hp) engine. Each machine shall be equipped with a two-speed transmission and shall be able to pull at a rate of 175 feet per minute (fpm) in high speed. Machines shall be belt operated or have an overload device. Machines with direct drive will not be allowed. The power rodding machine shall be either a sectional or continuous type capable of holding a minimum of 1,000 feet of rod. The machine shall have a positive rod drive and produce a minimum 2,000-pound rod pull. To ensure safe operation, the machine shall have a fully enclosed body and an automatic safety throw-out clutch or relief valve.

3.4 PRECAUTIONS

A. During pipeline cleaning operation, take precautions to protect the pipeline from damage that might be inflicted by the improper use of cleaning equipment. Whenever hydraulically propelled cleaning tools or any tools which retard the flow of water in the pipeline are used, take precautions to ensure that the water pressure created does not cause any damage or flooding to property. The flow in the pipeline shall be utilized whenever possible to provide necessary pressures

for hydraulic cleaning devices. When water from a fire hydrant is necessary to supplement flows, provide a vacuum break and conserve the water.

3.5 MATERIAL REMOVAL AND DISPOSAL

A. Remove all foreign material resulting from the cleaning operation at the downstream manhole of the pipeline section being cleaned. Do not pass material from section to section. Remove and dispose of all solids or semisolids resulting from the cleaning operations from the site in a manner and at a site designated and approved by the Owner. Remove all materials from the site at the end of each workday. Under no circumstances accumulate debris on the site of work beyond the stated time, except in totally enclosed containers and if approved by the Owner. Pull a double squeegee, with each squeegee the same size as the pipeline, through each pipeline section as evidence of being adequately cleaned.

B. The Contractor shall provide suitable equipment to remove all sediment & debris dislodged during cleaning operations. All material shall be promptly removed from the pipeline and transported to the influent manhole of the backwash lagoons for disposal by the Contractor.

C. The Contractor shall be responsible for transporting and disposing of all sediment & debris removed from the pipeline network. All haul routes shall be kept clean and the Contractor shall bear the responsibility of immediately cleaning any spills. If the Contractor does not clean up a spill, the OWNER will clean and charge the Contractor for all associated costs and fines.

D. Under no circumstances shall the removed materials be dumped at unlicensed facilities or transfer stations onto streets or into ditches, catch basins, storm drains, sanitary, or combined sewer manholes, or otherwise improperly disposed. The Contractor shall comply with all local, state and federal regulatory requirements regarding spills and illegal dumping. Improper disposal of sewage or solids removed from the pipelines may subject the Contractor to fines imposed by the Owner and other regulatory entities. In addition, the Contractor may be subject to civil and/or criminal penalties for improper handling or disposal of removed materials under the law.

E. **Hydraulically Cleaned Material**. When hydraulic cleaning equipment is used, construct a suitable weir or dam in the downstream manhole such that both the solids and water shall be trapped. Pump this trapped solution into a retention chamber aboveground. The retention chamber shall be of a size suitable for solid settlement and shall be truck mounted. The chamber shall contain not less than two baffles to ensure settlement of the solids before returning the liquid to the pipeline.

F. **Mechanically Cleaned Material**. When bucket machines are being used, provide a container to receive the materials dumped from the buckets.

3.6 PIPELINE CCTV INSPECTION

A. The pipeline shall be fully inspected through CCTV following the cleaning operation to confirm the cleanliness of the pipe and note any defects. PACP coding is NOT required.

B. **Equipment**. The camera(s) shall be operative in 100 percent humidity/submerged conditions. The CCTV camera equipment will provide a view of the pipe ahead of the equipment and of features to the side and rear of the equipment through turning and rotation of the lens or through turning and

rotation via viewing software. The camera or viewing software shall be capable of tilting at right angles along the axis of the pipe while panning through a full circle about the circumference of the pipe. The lights on the camera shall also be capable of panning 90-degrees to the axis of the pipe. If the equipment proves to be unsatisfactory, it shall be replaced with adequate equipment.

1. The television camera, electronic systems and monitor shall provide an image that meets the following specifications:
    a. With the monitor control correctly adjusted, the six colors - Yellow, Cyan, Green, Magenta, Red, and Blue, plus black and white shall be clearly resolved with the primary colors in order of decreasing luminance.
    b. The picture shall show no convergence or divergence over the whole of the picture. The monitor shall be at least 13-inches diagonally across the picture tube.
    c. The live picture on the CCTV monitor shall be capable of registering a minimum of 600 lines horizontal resolution and be a clear, stable image with no interference.
2. Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, in-focus picture of the entire inside periphery of the pipelines and laterals for all conditions except submergence. Under ideal conditions (no fog in the pipeline) the camera lighting shall allow a clear picture up to five pipe diameter lengths away for the entire periphery of the pipeline. The lighting shall provide uniform light free from shadows or hot spots.
3. Inadequate lighting, sewer gas, fog, mist, spray, wet or submerged camera lens, high flow levels, fast flow velocities, excessive camera movement, small window of viewable area, bypassing defects and connections without stopping/panning, poor video quality will be just cause for the Owner to require the pipeline to be re-televised by the Contractor at no additional cost to the Owner.
4. Camera focal distance shall be remotely adjustable through a range of 6-inches to infinity.
5. The monitor and software shall also be able to capture and save screen images of typical pipeline details and all defects.

C. **Video Recordings**. The video of the pipeline inspections shall be made using digital video equipment (.mpeg, .mpg, .wmv – one file for each reach inspection) for submission on portable hard drives. A video enhancer may be used in conjunction with, but not in lieu of, the required equipment. The digital recording equipment shall capture pipeline inspection, with each pipeline reach inspection recorded as an individual movie file (.mpeg, .mpg, .wmv). The video may contain audio, but it is not required.

D. **Inspection**. The CCTV camera shall be positioned as close to the spring line as possible while maintaining the required equipment stability. At the discretion of the OWNER, if water levels prevent adequate televising of the pipeline, then conducting the work during low flow periods or other methods detailed in the Contract Documents should be implemented. The inspection will be done one

pipeline section at a time and the section being inspected will be isolated from the remainder of the pipeline system. The camera shall be moved through the pipeline in either direction at a uniform slow rate by means of cable winches at each manhole. In no case will the video camera travel at a speed greater than 30 feet per minute. When pipeline conditions prevent forward movement of the camera, the Contractor shall withdraw the camera and televise the line from the opposite direction.

1. Contractor shall only perform inspection work when the flow depth is 50% of the pipe diameter or less, when measured at the centerline of the pipeline, unless otherwise directed by the Engineer. This is to ensure that enough of the pipe can be observed above the flow line during the CCTV inspection for the City's requirements. The City reserves the right to not accept inspection data if this criterion is not met. Flow depth is based on the centerline of the pipeline. Actual depth of flow and velocity may vary depending on slope, debris accumulation, and other obstructions. Pipeline flows shall at no time exceed 50% of the pipe diameter during the television and sonar combination inspection. Televising the pipeline when flows are more than 50% of the pipe diameter or televising when the camera is below the water surface shall be cause for Engineer to require the Contractor to re-televise the pipeline at no additional cost to the Owner. Some pipelines may have normal/dry weather flow depths in excess of 50% of the pipe diameter. The Contractor may coordinate with the Engineer's on-site representative in order to request permission to perform inspection when flow depths exceed 50% of the pipe diameter. Such requests and granting of permission will be done on-site in the field, on a case-by-case basis.

2. Contractor shall expect to perform manned entry of manholes and pipes in order to deploy and operate inspection and cleaning equipment.

E. If the Contractor's CCTV equipment becomes lodged in the pipeline, it shall be removed from the pipeline solely at the Contractor's expense. This shall include excavation and repair of the pipeline, underground utilities, backfilling and surface restoration.

3.7 SITE RESTORATION

A. After cleaning and televising a reach or reaches in an area, the work site shall be cleaned and restored to pre-work conditions. Restoration items, including, but not limited to, grading, topsoil, fertilizer, seeding and pavements. Any damage to existing utilities and/or facilities shall be paid at the Contractor's expense at no additional cost to the Owner.

END OF SECTION

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SECTION 33 05 01

CONNECTIONS TO EXISTING MAINS AND SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to accomplish connections to pipelines and sewers in service in accordance with the plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

A. **Notification**. Notify the Owner at least 2 working days in advance and all affected users at least 24 hours in advance of shutoffs. The notification shall include planned starting time and duration of interruption in service. The time and duration of interruption of service must be approved by the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 CONNECTING TO EXISTING UTILITIES AND STRUCTURES

A. Examination

1. Verification of Conditions. Verify the location and elevation of required construction. Confirm that conditions are acceptable to begin construction of work covered in the specification. Complete coordination with other construction or operation activity on the same facility or area. Expose all existing pipes within the work area to permit confirmation of pipe sizes, all required dimensions, elevations, precise locations, and materials of construction prior to ordering new materials and not less than 7 working days prior to date planned for actual connection.

B. Main Connection

1. Sequence of Work.
   a. Complete as much work as possible before making connections. New mains must be blocked, tested, sterilized, and approved prior to connecting to existing mains.
   b. Coordinate the work so that all labor, materials, tools, and equipment are on the site at the start of the work.
   c. Work continuously (24 hours per day, 7 days per week) until service is restored.
   d. Schedule the work to correspond with minimum flows, such as nights and weekends, to minimize inconvenience to customers.
2. Disinfection. Disinfect contaminated potable water pipe in accordance with Section 01 89 19, "Leakage Test and Disinfection."
3. Testing. Test the connection before backfilling.
4. Refilling. Refill the pipe from the system and evacuate all air through hydrants and air releases.
5. Demonstration. Comply with requirements of Section 33 05 30 Item 3.6.

C. Sewer Connection

1. Description. Provide for intercepting existing sewers and connecting new sewers to existing manholes where shown on the plans or where directed and as specified herein.
2. General. This work shall include neatly cutting out existing sewers within new manholes; abandoning sewers within new and existing manholes and plugging with concrete; connecting into and reshaping inverts within existing manholes to accommodate new sewers; and temporarily plugging new sewers within existing manholes. All plugs and connections shall be made watertight.

END OF SECTION

SECTION 33 05 13

MANHOLES AND INLETS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the manholes and inlets in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE** (Not used)

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. Submittal Package No. 1 – Shop Drawings and Product Data

1. Product Data. Furnish samples, manufacturer's product data, test reports, and materials certifications as required.
2. Shop Drawings. Provide detail drawings, sketches, and specifications as may be required to establish that the proposed manholes and inlets conform to the requirements of the plans and specifications.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 01 60 00, "Materials and Equipment."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 MANHOLES AND INLETS

A. **Sanitary Sewer Manholes**. Provide watertight manholes constructed only of cast-in-place concrete or precast concrete sections.

B. **Storm Sewer Manholes and Inlets**. Provide storm sewer manholes and inlets constructed of cast-in-place concrete, precast concrete, brick, or concrete block.

C. **Concrete**. Provide Class A, 4,000-pound-per-square-inch (psi), 28-day-strength portland cement concrete as specified in Section 03 30 00, "Cast-in-Place Concrete," in the construction of manholes and inlets.

D. **Concrete Reinforcement**. Provide reinforcement as shown and as specified in Section 03 30 00, "Cast-in-Place Concrete," in the construction of manholes and inlets.

E. Precast Reinforced Concrete Manhole Sections

1. Manhole sections shall conform to the requirements of American Society for Testing and Materials (ASTM) C 478, except that the minimum wall thickness shall be equal to the requirements of ASTM C 76 Wall B.
   a. Provide flat top manhole lid where shown on plans.

2. Additional Requirements for Sanitary Sewer Manholes Only.

   a. Form joints of the manhole sections entirely of concrete employing a round rubber gasket conforming to ASTM C 443, and when assembled, shall be self-centering and make a uniform watertight joint.
   b. If provided, make lift holes watertight.

3. Provide aluminum single or double leaf Access Doors as indicated on the drawings. Access doors shall be as shown on the plans and shall be capable of supporting an H-20 wheel load. The access doors shall be aluminum with stainless steel hardware. Frame shall be drainable type with upper rail bracket, chain hook, and cable holder. They shall have a frost proof lock with Tee-wrench access which can be opened from the inside without a key. A wind catch shall be provided to keep the covers from coming shut under normal load. Access doors shall be Bilco Type JD-AL H-20 or equal. Access doors shall be furnished with safety grates.

F. Connections

1. The sewer pipe to manhole connections on all sanitary sewers shall be flexible and watertight.

   a. To maintain flexibility in the connection, leave a 1-inch space between the end of the pipe inside the manhole and the concrete channel; fill this space with a waterproof flexible joint filler.

   b. The watertight connection shall meet the following requirements.

      1) Any metal or hardware that is used shall be Type 300 series stainless steel.
      2) Elastomers must be EPDM or isoprene.
      3) Comply with ASTM C 923.

2. Do not extend the sewer pipe barrel at the springline more than 1 inch beyond the inside face of the manhole.

3. All stub connections shall be pipe with the same joint, strength, and specification as the sewer pipe. Plug and block the stub with an approved stopper compatible with the sewer pipe joint.

G. Manhole Steps

1. Manhole steps shall conform to the requirements of ASTM C 478, American Association of State Highway Transportation Officials (AASHTO) M-199, and as shown.

2. Each manhole step shall consist of a 1/2-inch Grade 60 deformed reinforcing bar encapsulated in polypropylene.

    a. The polypropylene shall conform to ASTM D 4101.
    b. The reinforcing bar shall conform to ASTM A-615.

3. Do not exceed 24 inches between the top of casting and the first step.

H. Grade Adjustment

1. Provide precast reinforced concrete manhole sections, if used, in any combination to obtain the desired depth.

2. Construct manholes in such a manner that the total depth from invert to top of casting will allow a minimum of three adjusting rings or three brick courses below the top of casting.

3. All joints shall be smooth and completely filled with mortar.

4. Adjusting rings shall be one of the following:

    a. Precast concrete adjusting rings conforming to ASTM C 478.
    b. Expanded Polypropylene as manufactured by Cretex Specialty products or equal.

I. Frames and Covers for Manholes

1. Manhole frames and covers shall be gray iron castings of the heavy duty pattern as shown.
2. The cover and seat shall have machined bearing surfaces to prevent rocking and rattling.
3. Cast the words "SANITARY SEWER" or "STORM SEWER" as appropriate on all covers.
4. Provide vented covers except in pavement and where shown otherwise.
5. Where shown as "bolted" or "watertight," the manhole frames and covers shall be of the heavy-duty watertight type with gasket seal and bolted lid. Anchor frame to manhole with four 7/8" x 9" long stainless steel anchor bolts.
6. All covers shall have a concealed pick hole.
7. Do not provide more than two consecutive manholes with solid covers.
8. Provide solid covers for structures in pavement.

J. **Drop Manhole Connections**. Provide drop manhole connections for sanitary sewers when shown or as directed. Pipe and fittings shall be with the same joint, strength, and specification as the sewer pipe.

K. **Precast Reinforced Concrete Manhole Tees**. For sewers 48 inches in diameter and larger, precast concrete manhole tees may be used in lieu of concrete manhole bases when shown.

L. Mortar

1. Mortar shall be portland cement and sand mixed in the proportions of one bag of cement to 2 cubic feet of sand.
2. Measure the sand loose in a bucket or in some other suitable measure of known volume.
3. Mix the dry cement and sand thoroughly and uniformly first. Then wet with water to make a stiff paste which will be plastic under the trowel, but not so soft as to run after being placed.
4. Use the mortar before it has begun to stiffen.
5. Do not remix and use mortar that has set.

M. Masonry

1. All masonry joints shall be smooth and completely filled with mortar.
2. Brick shall conform to Grade MS as specified in ASTM C 32.
3. Concrete brick may be used on approval, providing they meet all of the requirements specified in ASTM C 139.
4. Solid concrete block shall conform to Grade N-1 as specified in ASTM C 145.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. **Foundation**. When a precast concrete manhole base is used, provide drainage base according to Section 31 23 00, "Excavation, Backfill, and Embankment." for the base foundation. The pad shall extend a minimum of 4 inches beyond the outside wall of the manhole base and shall be 6 inches thick within a 1-inch tolerance.

B. **Cold Weather**. If the work is carried on in cold weather, provide the necessary means for heating concrete, brick, and mortar and for complying with all the requirements of the Engineer/Architect to thoroughly protect the masonry and concrete work during and after construction from damage by frost. Do not perform any masonry or backfilling during days, in the opinion of the Engineer, that are unsuitable for good workmanship.

C. **Completion**. All sewers, manholes, and inlets, upon their completion, are to be clean and free from rubbish until the acceptance of the work. Repairs or alterations made to the manholes after performing the leakage test may be justification for a retest of the section of sewer involved; see Section 01 89 19 for the leakage test.

D. **Inverts**. Where there are changes in the direction of the sewer or entering branches to the manhole or inlet, the centerline of the invert shall have a true curve of as large a radius as the size of the manhole or inlet will permit.

E. **Concrete and Mortar Placement**. Place no mortar or concrete in water, and don't allow water to flow over or against the concrete or mortar before it has set for a period of time deemed sufficient to prevent damage to the structure.

END OF SECTION

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SECTION 33 05 13.13

RAISING OF MANHOLE LIDS BY ADDING CONCRETE MANHOLE SECTIONS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK.** Provide the labor, tools, equipment, and materials necessary to raise manholes in accordance with the details and as specified herein.

1.3 **QUALITY ASSURANCE** (not used)

1.4 **SUBMITTALS.** Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Product Data. Furnish samples, manufacturer's product data, test reports, and materials certifications as required.
2. Shop Drawings. Provide detail drawings, sketches, and specifications as may be required to establish that the proposed manholes and inlets conform to the requirements of the plans and specifications.

1.5 **JOB CONDITIONS.** Immediately remove all debris resulting from the work from the manhole and prevent its entering any sewer pipe or washing downstream.

1.6 **DELIVERY, STORAGE, AND HANDLING.** In accordance with Section 01 60 00, "Materials and Equipment."

1.7 **SPECIAL WARRANTY** (not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Precast Reinforced Concrete Manhole Sections**.

1. Precast reinforced concrete manhole sections shall conform to the requirements of American Society for Testing and Materials (ASTM) C 478.
2. Joints of the manhole sections shall be formed entirely of concrete, be self-centering, and make a uniform watertight joint utilizing a round rubber gasket conforming to ASTM C 443.
3. Lift holes, if provided, shall be made watertight.

B. **Manhole Adjustment**.

1. Frames and covers salvaged from existing manholes shall be set directly onto the raised precast concrete cone section and sealed with mortar.
2. Mortar shall be composed of Portland cement and sand, mixed in the proportions of one part cement to two parts sand as approved.
3. The sand shall be measured loose in a bucket or in some other suitable measure of known volume.
4. The cement and sand shall be mixed thoroughly and uniformly when dry. Then wet with water to make a stiff paste which will be plastic under the trowel, but not so soft as to run after being placed.
5. The mortar shall not be used after it has begun to stiffen. Mortar that has once set shall not be mixed and used.

C. **Concrete Encasement**. All cast-in-place concrete shall be in accordance with Section 03 30 00.

D. **Backfill**. All backfill shall be in accordance with Section 31 23 00, "Excavation, Backfill, and Embankment." Controlled density fill will not be accepted.

PART 3 - EXECUTION

3.1 PREPARATION

A. **Excavation**.

1. Perform excavation around each manhole in accordance with Section 31 23 00, "Excavation, Backfill, and Embankment," except as modified herein.
2. Excavate all material of whatever nature encountered necessary to complete the required work.

B. Disposal of Excavated Material

1. Do not use public or private property for the disposal of excavated material without approval.
2. Accomplish the removal of any obstructions that may be encountered and protect and support any existing utilities at own expense under the direction of the Engineer.
3. Include the cost of this work in the price bid for "Raising of Manhole."

3.2 INSTALLATION

A. **Raising of Manhole**.

1. Remove and salvage the existing manhole frame and lid from the top of the manhole.
2. Remove and dispose of the existing chimney portion of each manhole.
3. Remove the existing corbel and barrel section only as required to expose sound brick-and-mortar construction.
4. Carefully remove mortar from exposed bearing surfaces.

5. Place the precast manhole transition section onto the brick manhole bearing surface and construct a cast-in-place concrete transition joint between the brick and precast manhole sections as shown.
6. Construct the concrete transition joint in a neat, workmanlike manner in accordance with Section 03 30 00, "Cast-in-Place Concrete."
7. Add additional precast sections as necessary to raise the manhole casting to the required elevation.
8. Form watertight joints of the precast manhole sections.
9. Make lift holes, if provided, watertight.
10. Center the salvaged frame over the manhole and set directly onto the precast cone section.
11. Use fresh mortar to seal the frame against the cone section, as shown.
12. Trowel-finish exposed mortar for a good seal and smooth finish.
13. Payment for raising of manholes as described herein, including existing frame removal, demolition, cleaning, new precast reinforced concrete sections, cast-in-place concrete, finishing, disposal, and other appurtenant work will be made at the unit price bid per each for the item "Raising of Manhole."

B. **Cold Weather**.

1. If the work is carried on in cold weather, provide the necessary means for heating concrete and mortar and for complying with all requirements of the Engineer to thoroughly protect the masonry and concrete work during and after construction from damage by frost.
2. Don’t work on any masonry or backfilling during any days that are unsuitable for good workmanship in the opinion of the Engineer.

C. **Backfill**. All backfill shall be in accordance with Section 31 23 00, "Excavation, Backfill, and Embankment."

D. **Completion**. Clean and free all manholes, upon their completion, from rubbish and keep so until the acceptance of the work.

END OF SECTION

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SECTION 33 05 16.13

PRECAST CONCRETE VAULT

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **General**. Provide the labor, tools, equipment, and materials necessary to install precast vault in accordance with the plans and as specified herein.

B. **Extent of precast work required by this section** is indicated on drawings and this specification.

C. **Minimum Size Requirements**.

1. The dimensions of the precast concrete structure shown are minimum dimensions that must be maintained for placement of the piping and/or equipment shown.
2. Any changes or variations from that shown and specified due to manufacturer's variations shall be at no cost to the Owner.
3. The Contractor is responsible for any changes caused by the manufacturer unit provided.

D. **Openings in Precast Concrete**. The manufacturer of the precast concrete structure shall be responsible for all pipe sleeve penetrations and access hatches. Provide and install all concrete supports, piping, valves, and related accessories as shown.

E. **Ladder Rungs**. The manufacturer of the precast concrete structure shall provide the vaults with ladder rungs where shown.

1.3 **QUALITY ASSURANCE**

A. **Codes and Standards**. Perform all work associated with precast vaults in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. ASTM C 857, "Minimum Structural Design Loading for Underground Precast Concrete Utility Structures."

B. **Manufacturer Qualifications**. Manufacturers of precast vaults shall be firms regularly engaged in manufacturing factory fabricated vaults of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1. ASTM C 857, "Minimum Structural Design Loading for Underground Precast Concrete Utility Structures."

C. **The Engineer shall approve the vault design** prior to ordering of the units by the Contractor.

1.4 **SUBMITTALS**

A. **General**. Furnish manufacturer's product data, test reports, and material certification as required by Section 01 33 00, "Submittals."

B. **Submittals**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

1. Laboratory test reports for concrete materials mix design tests.
2. Shop drawings and structural calculations including fully dimensioned layout drawings, location of openings in vault, structural details, and waterproofing system.
3. Shop drawings shall be stamped by a professional engineer legally authorized to practice in the jurisdiction where the project is located.

1.5 **JOB CONDITIONS.** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING.**

A. **General.** Handle precast concrete vaults carefully to prevent external and internal component damage, breakage, cracking, or scoring. Do not install damaged equipment; either replace damaged components or return unit to factory for replacement.

B. **Comply with manufacturer's rigging and installation instructions** for unloading precast concrete vaults and setting in final location.

C. **Store precast concrete units at site** as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.7 **SPECIAL WARRANTY.** (Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Precast Vault Hardware and Accessories**

1. Access Door(s)

a. Furnish and install access doors and frames as shown.
b. Aluminum with stainless steel hardware.
c. Double-leaf or single-leaf spring-loaded door, complete with upper guide holder.
d. Design live loads shall be for a minimum of 300 pounds per square foot.
e. Door frames shall be cast-in-place in the concrete top. Pipe frame drainage to the exterior of the structure.
f. Skidproof surface.
g. Stainless steel hinges and stainless steel fasteners.

h. Open to 90 degrees and lock automatically in that position, with a stainless steel positive locking arm and a stainless steel release handle.
i. Stainless steel lifting handle and stainless steel locking bar.
j. Warranty of 10 years against defects in material and/or workmanship.

2. Reinforced polypropylene ladder steps.

B. **Vault Moistureproofing.** Provide heavy-fibrated-type mastic asbestos-free emulsion; ASTM D 1227, Type IV, except containing non-asbestos, inorganic fibrous reinforcement materials.

C. **Precast Vault**

1. Factory-fabricated of reinforced concrete and in conformance with American National Standards Institute (ANSI) and applicable requirements of American Society of Testing Materials (ASTM) C 478, "Specifications for Precast, Reinforced Concrete Manhole Sections."
2. Vault shall be sized as shown and constructed of precast concrete in two sections. The reinforced concrete shall utilize Grade 60 reinforcing bars and Type II cement with a concrete strength equal to 4,500 pounds per square inch (psi).
3. Precast units consisting of interlocking, mating sections, complete with accessory items, hardware, and features as indicated including concrete knockout panels for pipe entrance and exit.
4. Joint sealant for joints between precast sections shall be continuous extrusion of asphaltic butyl material compounded for the adhesion, cohesion, flexibility, and durability properties required for a permanent seal against the maximum hydrostatic pressures theoretically attainable at the installation location with the ground water level at grade.

D. **Appurtenances**

1. Appurtenances. Provide the following items as indicated and shown with the utility vault.

a. Mechanical expandable link-type rubber seal and steel wall sleeve to fill the annular space between a pipe and cored hole or sleeve which passes through the utility vault walls.
b. Cast iron bodied floor drain with 4-inch outlet pipe size, if shown.
c. Vent pipe with insect screen.

2.2 MANUFACTURERS

A. **Available Manufacturers**. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:

1. Precast Vaults.

a. E.C. Babbert, Inc.
b. Hartford Concrete Products, Inc.
c. Norwalk Concrete Industries.
d. Mack Industries, Inc.
e. United Precast, Inc.

2. Aluminum Frames and Covers.

a. Bilco Co.
b. Halliday Industries.
c. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**.

1. Provide vault of sizes, shapes, and locations as shown.
2. Determine final grading as influenced by possible adjustments in other utilities and surface features and discovery of underground obstructions before installing vault.
3. Obtain approval for vault installation adjustments necessitated by the above.
4. Install units plumb and level and with orientation and depth coordinated.
5. Install vault with rooftop at elevation shown.

B. **Drainage**. Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.

C. **Precast Access Door**.

1. Install access door in vault at the shop.
2. Caulk all seams and joints inside and out.
3. Set frames in paved areas and traffic ways flush with finished grade.

D. **Waterproofing**.

1. Apply waterproofing to exterior surfaces of units after concrete has cured at least 3 days.
2. Apply by brushing or spraying at rate of 5.0 gallons per 100 sf, to produce uniform dry film thickness of not less than 30 mils.
3. After pipes have been connected and grouted in, and prior to backfilling, waterproof joints and connections and touch up abrasions and scars.

F. **Field-Installed Bolting Anchors**. Do not drill deeper than 3 7/8 inches for anchor bolts installed in the field.

3.2 INSTALLATION OF PRECAST VAULT

A. **Install in accordance with ASTM C 891**, "Practice for Installation of Underground Precast Concrete Structures," and manufacturer's instructions.

B. **Foundation**. Provide drainage base according to Section 31 23 00, "Excavation, Backfill, and Embankment." for the base foundation. The pad shall extend a minimum of 4 inches beyond the outside wall of the vault base and shall be 6 inches thick with a 1-inch tolerance.

3.3 FIELD TESTING

A. **Watertightness**.

1. Make internal inspection of vault 3 months after completion of construction for indications of water ingress.
2. Where leakage is noted, remove any water found and seal leakage sources.
3. Reinspect after 2 months and reseal any remaining leakage sources.
4. Repeat process at 2 month intervals until leakage is corrected.

3.4 CLEANING AND RESTORATION

A. **Cleaning**. Clean all internal surfaces including sump and remove all foreign material.

B. **Restoration**.

1. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.
2. Where sod has been removed, replace it as soon as possible after backfilling is completed.
3. Restore all areas disturbed by trenching, storing of dirt, and other work to their original condition.
4. The restoration shall include a necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.
5. Restore disturbed paving as indicated.

END OF SECTION

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SECTION 33 05 30

PRESSURE PIPE, FITTINGS AND VALVES, INSTALLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to install the pipe and fittings in accordance with the drawings and as specified herein. The work includes, but is not limited to, the following:

1. Excavation, preparation of the trench bottom and bedding.
2. Shoring and bracing.
3. Piping beginning at the outside face of structures or building foundations, unless specifically included under other sections.
4. Piping beneath structures.
5. Installation of supports, restraints, and thrust blocks.
6. Work on existing buried pipelines.
7. Installation of all joints, fittings, specials, couplings, adapters, sleeves, tie rods, jointing and gasketing materials, and all other work required to complete the piping installation.
8. Valves, gates, and specials shown or specified for the piping systems.
9. Testing and disinfection.
10. Cleaning.
11. Trench maintenance.

1.3 QUALITY ASSURANCE

A. **Standards**. Conform all materials and workmanship with the following standards.

1. AASHTO – American Association of State Highway and Transportation Officials.
2. Ohio EPA – Environmental Protection Agency.
3. ANSI – American National Standards Institute.
4. ASTM – American Society for Testing and Materials.
5. AWWA – American Water Works Association.
6. PPI – Plastic Pipe Institute.

B. **Trench Maintenance**. Be responsible for the condition of the trenches for a minimum period of one year from the date of the final acceptance, which must include the period of November 1 to the following April 30. Extend the contract bond to cover the entire trench maintenance period.

1.4 SUBMITTALS

A. General

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and this specification section.

B. Submittal Package No. 1 – Backfill Product Data

1. Submit product data for review and approval. Submittal package shall include:

    a. Product Data. Submit material data, noting each material source, location, sieve analysis, and other information which will show that the source and supplier are capable of furnishing materials meeting the requirements of these specifications. Submit name and location of all borrow pits. Product data is required for the following:

        1) Granular pipe bedding.
        2) Granular backfill.

1.5 JOB CONDITIONS

A. **Testing**. Provide all water required for testing at no additional cost to the Owner. Do not pressure-test polyvinyl chloride (PVC) and polyethylene (PE) pipe when the temperature of the pipe is over 80 degrees Fahrenheit (° F.).

B. **Cleaning**. Provide all water required for cleaning and flushing at no additional cost to the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General

1. Delivery, storage, and handling shall be in accordance with Section 01 60 00, "Materials and Equipment."
2. Pipe, fittings, and accessories that are cracked, damaged, or in poor condition, or have damaged linings will be rejected.
3. Pipe handled on skidways shall not be skidded or rolled against other pipe.
4. Protect PVC or PE pipe from exposure to heat or direct sunlight (ultraviolet rays).

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 GENERAL

A. **Pipe and Fittings**. Conform all buried piping, fittings, and joints to the drawings and requirements specified in the corresponding section for each type of pipe installed.

B. **Manufacturer**

1. All new buried piping of one material shall be by a single manufacturer.
2. All buried fittings of one material shall be by a single manufacturer.
3. All pipe and fittings manufactured outside the United States shall be certified to ISO 9001:2000 standards for quality assurance.

C. **Identification**

1. Paint or cast all pipe and fittings 4 inches in diameter and larger with the pipe size, material, and class or schedule on the exterior pipe surface.
2. Factory-mark all piping less than 4 inches in diameter with the pipe size, material, and class or schedule on the exterior pipe surface.

2.2 BACKFILL

A. **Granular Pipe Bedding**. Crushed stone or gravel meeting the following requirements:

Nominal Pipe Size	AASHTO M43 Size
Less than 16 "	7, 78, 8, or 89
Greater than 16"	6, 67, or 68

B. **Selected Excavated Trench Material**

1. Free from cinders, refuse, organic material, boulders, rocks, frozen material, or other material which in the opinion of the Engineer is unsuitable.

C. **Excavated Trench Material**

1. Free from frozen earth, debris, or earth with an exceptionally high void content.

D. **Granular Backfill**. Granular backfill materials shall be gravel, crushed gravel, crushed stone, or sand meeting the following grading requirements:

Sieve	Total Percent Passing
2-1/2 inch	100
1 inch	70 – 100
No. 4 (3/16 inch)	25 – 100
No. 40	10 – 50
No. 200	5 – 15

The fraction passing a No. 40 sieve shall have a liquid limit not greater than 30 and a plasticity index not greater than 6.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions**

1. Verify the location and elevation of required construction.
2. Confirm that conditions are acceptable to begin construction of the work covered in the specification.
3. Coordinate with other construction or activities in the same facility or area.

3.2 PREPARATION

A. **Safety**. For the security and safety of persons in and adjacent to trenches or construction operations, follow the safety regulations of the appropriate federal, state, and local agency.

B. **Dewatering**

1. Should water be encountered, furnish and operate suitable pumping equipment of adequate capacity to dewater the trench.
2. Sufficiently dewater the trench so that the laying and joining of the pipe is in the dry.
3. Convey all trench water in accordance with the requirements contained in the National Pollutant Discharge Elimination System (NPDES) program.
4. Convey all trench water to a natural drainage channel or storm sewer without causing any property damage.

C. **Construction Equipment**. Where mains are located in or adjacent to pavements, all backfilling and materials handling equipment shall have rubber tires. Use crawler equipment only where there is no danger of damaging pavement.

D. **Noise, Dust, and Odor Control**. Conduct construction activities so as to eliminate all unnecessary noise, dust, and odors. Do not use oil or other materials for dust control which may cause tracking.

3.3 INSTALLATION

A. Protection of Trees

1. Take special care to avoid damage to trees and their root systems.
2. Do not use machine excavation when, in the opinion of the Engineer, it would endanger the tree.
3. Where the line of trench falls within the limits of the limb spread, headers are required across the trench to protect the tree.
4. Conduct the operation of all equipment (particularly when employing booms), the storage of materials, and the deposition of excavation in a manner which will not injure trees, trunks, branches, or their roots unless such trees are designated for removal.

B. Excavation and Construction Materials.

1. Place all excavated material and all construction materials used in the work so as not to endanger the work, annoy the public, or interfere with natural drainage courses.
2. During the process of the work, maintain all material piles in a neat, workmanlike manner.

C. Trench Support

1. Unsupported open cut trenches will not be permitted where they may cause unnecessary damage to pavement, trees, structures, poles, utilities, or other private or public property.
2. During the progress of the work, support the sides of the excavation by adequate and suitable sheeting, shoring, bracing, or other approved means.
3. Remove trench support material and equipment when backfilling operations have progressed to the point where they may be withdrawn without endangering property.
4. In lieu of removing all the sheeting, you may cut off the sheeting 2 feet above the top of the pipe and remove the upper portion.
5. If all the sheeting is to be removed, remove it without causing damage to the pipe.
6. No sheeting, shoring, or bracing will be paid for by the Owner unless remaining in place on written order of the Engineer. In this case, payment will be made in accordance with the General Conditions.

D. **Trench Excavation and Bottom Preparation**

1. Trench Width. Hold widths of trenches to a minimum to accommodate the pipe and appurtenances. Measure the trench width at the top of the pipe barrel and shall conform to the following limits:

a. Pipe.

Earth

Minimum	Outside diameter of the pipe barrel plus 8 inches, i.e., 4 inches each side
Maximum	Nominal pipe diameter plus 24 inches

Rock

	Nominal Pipe Diameter 24 inches or less	**Nominal Pipe Diameter Larger than 24 inches**
Minimum	Outside diameter of the pipe barrel plus 12 inches, i.e., 6 inches each side	Outside diameter of the pipe barrel plus 18 inches, i.e., 9 inches each side
Maximum	Nominal pipe diameter plus 24 inches	Nominal pipe diameter plus 24 inches

b. Structures. The minimum excavation limits for structures shall be as excavated. In rock, the excavation limits shall not exceed 12 inches from the outside wall and 6 inches below the footer.

c. Excessive Trench Width. If for any reason the trench width exceeds the maximum trench width defined in this section, provide granular pipe bedding, additional strength pipe, or concrete encasement, at no cost to the Owner and subject to acceptance.

2. Trench Depth.

a. Earth.

1) Excavate the trench to the depth required.
2) Provide a uniform and continuous bearing and support for the pipe barrel on solid and undisturbed ground at every point between joints.
3) It will be permissible to disturb the finished trench bottom over a maximum length of 18 inches near the middle of each length of pipe for the withdrawal of lifting tackle.
4) Provide bell holes.

5) Accurately prepare the finished trench bottom by means of hand tools.

b. Rock.

1) Where excavation is made in rock or boulders, excavate the trench 6 inches below the pipe barrel for pipe 24 inches in diameter or less, and 9 inches for pipe larger than 24 inches in diameter.
2) Remove all loose material from the trench bottom.

3. Rock Excavation.

a. Rock excavation is defined as the removal of:

1) Unanticipated solid concrete (excluding pavements), unanticipated solid masonry, or boulders each of which has a volume greater than 1 cubic yard.
2) Bedrock which requires for its removal drilling and blasting, wedging, sledging, barring, or breaking up with a power-operated tool.

b. Rock excavation is not excavating:

1) Existing concrete or masonry structures or pavements shown on the plans.
2) Material which can be excavated using an appropriately sized, heavy-duty, power-operated excavator, backhoe, or shovel, all of which are equipped with bucket-mounted ripping teeth.
3) Material that can be excavated with a hand pick and shovel.
4) Soft or disintegrated bedrock such as weathered shale, clay shale, claystone, or mudstone, or overconsolidated soils such as "hardpan."
5) Previously blasted materials or materials that are intermittently drilled and blasted to merely increase production.

c. Blasting Rock. Do not blast rock unless approved.

E. **Pipe, Fittings, and Valve Installation**

1. Pipe Laying.

a. Lay pipe with bell ends facing in the direction of laying, unless otherwise directed.
b. After placing a length of pipe in the trench, center the spigot end in the bell and force the pipe home.
c. Lay all pipe with ends abutting and true to line and grade.
d. Deflection of pipe joints in excess of the manufacturer's recommendations will not be permitted.

e. Provide a watertight pipe plug or bulkhead to prevent the entrance of foreign material whenever pipe laying operations are not in progress.
f. Inspect cast metal pipe and fittings for cracks by ringing the pipe with a light hammer while it is suspended.

2. Pipe Cutting.

a. Cut pipe in a neat and workmanlike manner without damage to the pipe or lining.
b. The end shall be smooth and at right angles to the axis of the pipe.
c. Flame cutting of metal pipe by means of an oxyacetylene torch will not be permitted.

3. Push-On Joints.

a. Thoroughly clean the surfaces with which the rubber gasket comes in contact just before assembly.
b. Then insert the gasket into the groove in the bell.
c. Before starting joint assembly, apply a liberal coating of special lubricant to the spigot end.
d. With the spigot end centered in the bell, push the spigot end home.

4. Mechanical Joints.

a. Center the spigot in the bell.
b. Thoroughly clean the surface with which the rubber gasket comes in contact just before assembly.
c. Brush these clean surfaces with a special lubricant just before slipping the gasket over the spigot end and into the bell.
d. Also brush the lubricant over the gasket before installation to remove the loose dirt and lubricate the gasket as it is forced into its retaining space.

5. Restrained Joints.

a. Ball and Socket or Push-On. Assemble and install the ball and socket joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.

6. Joints between Dissimilar Pipe Materials. Make connections to pipe of different materials with adaptors designed to join those materials.

7. Setting Valves.

   a. Set valves on a firm foundation so that no load will be transferred to the connecting pipe.
   b. Provide a valve box for every buried valve.
   c. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve.
   d. Set the box cover flush with the surface of the finished pavement unless otherwise shown.

8. Anchoring. Provide all plugs, caps, tees, and bends with a concrete backing and restrained fittings. If shown or specified, prevent movement by attaching suitable metal rods, clamps, or restrained fittings.

   a. Concrete Backing.

      1) Concrete backing shall be Design Mix A concrete as specified in Section 03 30 00, "Cast-In-Place Concrete."
      2) Place backing between undisturbed ground and the fitting to be anchored.
      3) The area of bearing on the fitting and on the ground shall be as shown.
      4) Place the backing, unless otherwise shown, so that the pipe and fitting joints will be accessible for repair.

   b. Tie Rods.

      1) Place steel tie rods or clamps, where permitted, of adequate strength to prevent movement.
      2) Paint steel tie rods or clamps with three coats of an approved bituminous paint or coal tar enamel.

   c. Restrained Fittings. Restrained fittings shall be supplied by the Contractor, as well as concrete backing.

F. **Trench Backfill**. Backfill all trench excavations immediately after pipe is laid as shown and specified.

1. Foundation.

   a. Build the mains on a good foundation.
   b. If, in the Engineer’s opinion, the material forming the trench bottom is not suitable for a good foundation, replace it with granular pipe bedding as directed.
   c. Authorized excavation and restoration of the foundation below the trench bottom will be paid for in accordance with the General Conditions.
   d. Fill unauthorized excavation below the trench bottom with pipe bedding at no cost to the Owner.

2. Pipe Bedding.

    a. Install all plastic or fiberglass-reinforced plastic (FRP) pipes with a 6-inch-deep granular pipe bed.
    b. Install all other pipe materials with no pipe bed unless foundation is rock.
    c. For rock foundations, provide a 6-inch granular pipe bed between rock and pipe for pipes 24 inches in diameter or less and a 9-inch granular pipe bed for pipes larger than 24 inches in diameter.
    d. Spread granular pipe bedding the full width of trench bottom.

3. Haunching.

    a. Use compacted selected excavated trench material unless noted otherwise.
    b. Place in uniform 6-inch loose layers and compact each layer to eliminate the possibility of settlement, pipe misalignment, or damage to joints.

4. Initial Backfill.

    a. Use selected excavated trench material unless noted otherwise.
    b. Take care to avoid injuring or moving the pipe.

5. Final Backfill.

    a. Use excavated trench material unless noted otherwise.
    b. Use mechanical equipment to place the backfill.
    c. Do this in such a manner that the material does not free fall, but so that it will flow onto the previously placed material.
    d. Consolidate the backfill to ensure the minimum possible settlement.
    e. No compacting of the backfill with mechanical equipment, such as wheeled vehicles, will be permitted unless sufficient cover is provided over the pipe to prevent damage to the pipe.

6. Granular Backfill. When backfilling under pavements, driveways, or as directed, use granular backfill in place of the selected excavated trench material and the excavated trench material. Trench granular backfill shall be used under any existing or future sidewalk, driveway; under all roadways; in any excavation that lies within the 1:1 influence line from any existing edge of sidewalks, driveways or roadways; and as directed by the engineer according to specification section 31 23 23.14.

7. Backfill trenches with Class C concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.

8. Provide 4-inch-thick concrete base slab support for piping or conduit less than 2'-6" below surface of roadways. After installation and testing of

piping or conduit, provide minimum 4-inch-thick encasement (sides and top) of concrete prior to backfilling or placement of roadway subbase.

9. Bulkheads.

   a. When granular bedding or backfill is provided, place bulkheads of clay soil across the trench at 100 foot intervals to resist the movement of groundwater through the granular material.
   b. Carefully compact the bulkheads and extend them approximately 3 feet in the direction of the pipe and from the bottom of the trench to a height of 6 inches above the top of the pipe barrel.

10. Surface Conditions. Periodically attend to the trench surface during the course of the Contract. Maintain the trench surface in a safe condition and not interfering with natural drainage.

3.4 CLEANING

A. **Cleanup**. After a section of main is tested and accepted, clean the ground surface of all surplus material including stone, broken pipe, construction material, and all other debris.

3.5 DEMONSTRATION

A. **Leakage Test and Disinfection**. In accordance with Section 01 89 19, "Leakage Test and Disinfection."

B. **Visual**. With Owner and/or Engineer, visually review the main installation for completion. Demonstrate that all main materials and appurtenances are in conformance with the Contract Documents.

C. **Final Acceptance**. The visual demonstration for completion of the main installation shall not be considered as final acceptance of the work. Correct all discrepancies "punch listed" at final inspection to the satisfaction of the Engineer and Owner.

3.6 **PROTECTION**. Protect the main appurtenances (valves, hydrants, etc.) from damage during subsequent construction operations. Remove any and all protection at the completion of the project.

END OF SECTION

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SECTION 33 05 33

PRESSURE PIPE AND FITTINGS, DUCTILE IRON

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Section 33 05 30, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK.** Provide the labor, tools, equipment, and materials necessary to furnish and install the buried ductile iron pipe and fittings in accordance with the drawings and specifications. See Division 40 for exposed flanged ductile iron piping.

1.3 **QUALITY ASSURANCE.** In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.4 **SUBMITTALS.** Submit the following submittal packages in accordance with section 01 33 00, "Submittals." Both packages shall be submitted, reviewed, and approved before installation of the pipe.

A. **Submittal Package No. 1 – Pipe Material and Testing Data**

1. Certification of compliance with the referenced standards.
2. Description of proposed testing methods, procedures, and apparatus.
3. Manufacturer's product data clearly marked for this specific project showing materials, sizes, thicknesses, pressure ratings, coatings, and joint configuration strengths.

1.5 **JOB CONDITIONS.** In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.6 **DELIVERY, STORAGE, AND HANDLING.** In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.7 **SPECIAL WARRANTY.** (Not used.)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Ductile Iron Pipe**. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51, "Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids."

1. Material. The chemical constituents shall meet the physical property recommendations of ASTM A 536, "Ductile Iron Castings," to ensure that the iron is suitable for satisfactory drilling and cutting.

2. Minimum Thickness.

a. Unless otherwise shown, the minimum thickness of the barrel of the pipe shall be:

Size	Thickness Class
3" – 12"	51
14" – 24"	52
30" – 48"	53

b. Unless otherwise shown, the minimum thickness of the barrel of restrained ball and socket joint pipe (river crossing) shall be:

Size	Thickness Class
4" – 6"	54
8" – 12"	55
14" – 24"	56
30" – 36"	57

3. Coating and Lining.

a. General. Unless noted otherwise, coat the pipe exterior with a bituminous coating in accordance with ANSI/AWWA C151/A21.51, "Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids," and lined inside with cement mortar and seal coated in accordance with ANSI/AWWA C104/A21.4, "Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water."

b. Air Mains. All ductile iron air main interiors shall be unlined.

B. **Ductile Iron Fittings**. Ductile iron standard and special fittings shall conform to ANSI/AWWA C110/A21.10, "Ductile Iron and Gray Iron Fittings," or ANSI/AWWA C153/A21.53, "Ductile Iron Compact Fittings."

1. Working Pressures. Fittings shall be suitable for the following working pressures unless otherwise noted:

Sizes	Pressure (psi) Gray Iron	Pressure (psi) Ductile Iron
2" – 12"	250	
14" – 48"	150	
3" – 24"		350
30" – 48"		250

2. Coating and Lining.

a. General. Unless noted otherwise, coat the fittings exterior with a bituminous coating in accordance with ANSI/AWWA C110/A21.10, "Ductile Iron and Gray Iron Fittings," or ANSI/AWWA C153/A21.53, "Ductile Iron Compact Fittings,"

and lined inside with cement mortar and seal coated in accordance with ANSI/AWWA C104/A21.4, "Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water."

b. Air Mains. All ductile iron fitting interiors on air mains shall be unlined.

C. **Joints**

1. Push-On and Mechanical (Including Restrained Joints). Push-on and mechanical joints including accessories shall conform to ANSI/AWWA C111/A21.11, "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings." Bolts shall be high-strength low-alloy steel tee head with hex nuts.

2. Flanged. Do not use flanged joints in underground installations except where specified or shown. See Section 40 05 13, "Process Piping, General," for more information on flanged joints.

3. Ball and Socket. Ball and socket joints (river crossing) shall be restrained, boltless, and capable of deflecting up to 15 degrees. The bell, ball, and retainer shall be cast of ductile iron. The gasket shall be of high quality rubber.

4. Gaskets.

   a. Air and gas piping shall have high-temperature-type gaskets, rated to 300 degrees Fahrenheit (° F.). Material shall be a fluoroelastomer (FKM).
   b. All gasket types shall be suitable for the material being conveyed.

5. Restrained.

   a. Allowable only where shown or approved.

   b. Rated at the pressure rating of the pipe with a safety factor of 2.

   c. Coat any exposed ferrous surfaces in accordance with AWWA C550. Alternatively, coat the casting body with a TGIC polyester and the wedges and wedge actuators with a fluoropolymer.

   d. Unless noted otherwise, any bolts shall be high strength low-alloy steel tee head with hex nuts.

      1) Any bolts for the waterline shall be stainless steel tee head with hex nuts.

   e. Subject to compliance with the specifications, provide a restrained joint system from one of the following approved manufacturers.

1) Ebaa Iron (3-48-inch diameter [dia.]).
2) Smith Blair (3-24-inch dia.).
3) Romac Industries (3-24-inch dia.).
4) Star Pipe (3-48-inch dia.).

D. **Polyethylene Encasement**. Where noted, encase the pipe and fittings with polyethylene film conforming to ANSI/AWWA C105/A21.5, "Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids."

PART 3 - EXECUTION.

3.1 Install all pipe and fittings in conformance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves."

END OF SECTION

SECTION 33 05 34

PRESSURE PIPE AND FITTINGS, POLYVINYL CHLORIDE (C900/C905)

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Section 33 05 30, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the polyvinyl chloride (PVC) pipe and fittings in accordance with the plans and the specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.4 **SUBMITTALS**. Submit the following submittal packages in accordance with the Division 1 submittal requirements.

A. **Submittal Package No. 1 – Product Data**

1. Schedule. No pipe shall be delivered until this submittal is approved.

2. Submittal Package Contents.

a. Certification of compliance with the referenced standards.
b. Manufacturer’s product data showing materials, sizes, thicknesses, pressure ratings, coatings, and joint strengths.

1.5 **JOB CONDITIONS**. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **PVC Pipe**. PVC pipe shall meet the requirements of the following AWWA standards.

Pipe Inside Nominal Diameter (inches)	AWWA* Standard
4 to 12	C900
14 to 48	C905

*AWWA – American Water Works Association

1. Unless otherwise shown, the minimum thickness of the barrel of the pipe shall be Dimension Ratio (DR) 25.
2. The pipe shall have cast iron pipe equivalent outside dimensions for the nominal size indicated.
3. Mark pipe with a ring on the plain end of the pipe to indicate proper insertion depth and to facilitate correct assembly of the joint.

B. **Fittings**. Fittings shall conform to one of the following standards and have a pressure rating equal to or greater than the pipe.

1. Ductile Iron. AWWA C110 or C153. Polyethylene encase all ductile iron fittings furnished for use with PVC pipe in accordance with AWWA C105.
2. Fabricated PVC Fittings. C900 or C905.
3. Injection-Molded PVC Fittings. C907. Only available for DR 25 and DR 18 pipe with diameters between 4 and 12 inches.

C. **Pipe Joints**

1. Push-on. Conform to ASTM D3139, "Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals."

2. Solvent-Cemented. Solvent-cemented joints are prohibited.

3. Restrained.

   a. Allowable only where shown or approved.

   b. Rated at the pressure rating of the pipe with a safety factor of 2.

   c. Coat any exposed ferrous surfaces in accordance with AWWA C550. Alternatively, coat the casting body with a TGIC polyester and the wedges and wedge actuators with a fluoropolymer.

   d. Any bolts shall be stainless steel tee head with hex nuts.

   e. Subject to compliance with the specifications, provide a restrained joint system from one of the following approved manufacturers.

      1) Ebaa Iron (3-48-inch diameter [dia.]).
      2) Eagle Lok 900 /Diamond Lok-21 (4-12-inch dia. DR 18 only).
      3) Smith Blair (3-24-inch dia.).
      4) Romac Industries (3-24-inch dia.).
      5) Star Pipe (3-36-inch dia.).
      6) Certa-Lok (4-16-inch dia.).

PART 3 – EXECUTION. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation," and AWWA C605**.**

END OF SECTION

SECTION 33 05 38

PRESSURE PIPE AND FITTINGS, PRESTRESSED CONCRETE CYLINDER PIPE (PCCP)

PART 1 GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Section 33 05 30, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the reinforced concrete-steel-cylinder-type prestressed pressure pipe and fittings in accordance with the plans and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

A. Pipe shall be designed in accordance to AWWA's Concrete Pressure Pipe M9 Design Standards.

1.4 **SUBMITTALS.** Submit the following submittal packages in accordance with Section 01 33 00, "Submittals." Both packages shall be submitted, reviewed, and approved before installation of the pipe.

A. Submittal Package No. 1 – Pipe Material and Testing Data

1. Certification of compliance with the referenced standards.
2. Description of proposed testing methods, procedures, and apparatus.
3. Manufacturer's product data clearly marked for this specific project showing materials, sizes, thicknesses, pressure ratings, coatings, and joint configuration strengths.

B. Submittal Package No. 2 – Detailed Drawings, Layout Schedule, and Thrust Calculations

1. Detailed profile drawings for all piping and fittings showing full details of piping, specials, and connections to existing pipes and structures.
2. Layout Schedule. Prior to manufacture, a tabulated layout schedule shall be furnished to the Engineer/Architect by the Contractor or the pipe manufacturer. The Contractor shall be responsible for the completeness of the tabulated layout schedule and for conformance to the requirements of the plans.
3. Thrust restraint design calculations.

1.5 **JOB CONDITIONS**. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves, Installation."

1.7 SPECIAL WARRANTY (Not used.)

PART 2 PRODUCTS

2.1 MATERIALS

A. **Prestressed, Reinforced Concrete Pipe.** Prestressed concrete pipe, steel cylinder type shall meet the requirements of American National Standards Institute/American Water Works Association (ANSI/AWWA) C301, "Prestressed Concrete Pressure Pipe, Steel Cylinder Type."

1. Design. The pipe shall be in conformance with ANSI/AWWA C301, "Design of Prestressed Concrete Cylinder Pipe," and AWWA Manual M9 and, unless otherwise shown, shall meet the following requirements:

a. Working Pressure. 150 pounds per square inch (psi).

b. Surge Pressure. 100 psi.

c. Cover. 8 feet or as shown on the Contract Drawings; whichever is greater.

d. Unit Weight Soil. 130 pounds per cubic foot (Ku = 0.130).

e. Live Load. Two 16,000 pound wheel loads passing 3 feet apart (impact factor = 1.5).

f. Laying Condition. Flat bottom trench, backfill thoroughly compacted to centerline of pipe (Bedding angle = 45 degrees).

g. Factor of safety = 2.5 applied as follows:

1. Internal pressure (working pressure plus surge pressure) with a 2.5 factor of safety.

2. Trench load (earth load plus truck load) with a 2.5 factor of safety.

3. The points as described shall fall on or below the burst pressure and the ultimate load values of the pipe.

b. Pipe shall be a lined-cylinder-type composted of a steel cylinder lined with concrete and subsequently wire-wrapped and coated with premixed mortar. The reinforced pipe shall be a continuous arc welded steel cylinder with steel joint rings welded to the ends.

c. Pipe shall be designed to handle a HS-20 truck load in accordance with AASHTO Specifications.

2. Calculations. Submit pipe design calculations for approval. No approval will be granted prior to the bid date. Pipe design calculations shall include the following for each pipe diameter:

a. Steel cylinder thickness, test pressure, yield point, ultimate strength, and American Society for Testing and Materials (ASTM) specification.

b. Wire, size, spacing, tensile strength, and ASTM specification.

c. Burst pressure.

d. Ultimate load.

e. Initial concrete core stress (f_{ic}).

f. Compression strength of concrete at the time of wrapping (rodded test cylinder strength).

g. Core thickness including cylinder.

h. Outside coating thickness (minimum over wire and nominal).

i. Static and transient envelope curves.

j. n_i', n_r', n_i, n_r, R, φ, S, f_{yb}, f_{sg}, f_{su}, D_y, h_c, A_s, t_y, f_{cr}, P'_k, P_b, P_o, P_w, W_e, W_p, W_w.

3. Inventory and Plant Observation.

a. Inventory. Supply no pipe from inventory unless approved.

b. Plant Observation. Unless otherwise specified, all pipe, fittings, adapters, and accessories shall be observed by the Owner's representative during manufacture.

4. Fittings.

a. Steel Cylinder. The steel cylinders for bends, tees, reducers, and other fittings shall also conform to Section 4.2 of ANSI/AWWA C301, “Prestressed Concrete Pressure Pipe, Steel Cylinder Type.” The minimum thickness shall be as follows:

Nominal Diameter	**Minimum Wall Thickness**
16”	0.179”
20”	0.219”
24”	0.250”
30”	0.312”
36”	0.375”
48”	0.500”

b. Weld Tests. Inspect and test all welds for tightness by the dye penetrant or other approved method.

c. Outlets. Line and coat the interior and exterior surfaces of all steel outlets with mortar. Coat all exposed steel with an epoxy suitable for potable water immersion service.

5. Adapters and Other Accessories. Stock a number of bevel adapters and short lengths of pipe at the job site to be used for diverting the pipe past obstructions or to make any changes in the line and grade of the pipe due to omissions on the tabulated layout. Provide at no additional cost to the Owner bevel pipe, outlet connections on straight pipe, closures, and other accessories as required to satisfactorily install the pipe as shown.

6. Plant Hydrostatic Test.

a. Notice. Give notice to the Owner's representative at least 1 week prior to the test so that they may witness the test.
Procedure.

1. The manufacturer shall conduct a hydrostatic test at the combined working and surge pressure applied for at least 20 minutes.

2. After attaining its design strength (approximately 28 days), one length of pipe of each size cast for this project shall be selected by the Owner's representative for testing.

3. All equipment necessary to conduct the test shall be provided by the manufacturer.

4. Before the test is applied, the pipe may be filled with water and allowed to stand under a pressure of 10 psi for a period not to exceed 48 hours

b. Acceptance.

1. The pipe must withstand the hydrostatic test without cracking or leaking.

2. Very fine shrinkage and hair cracks less than 0.005 inch in surface width and not over 1 foot long, unharmful in nature, will not be cause for rejection.

3. In the event that a pipe fails to withstand the test to the satisfaction of the Owner's representative, the manufacturer shall have the right to test two other sections of pipe selected at random by the Owner's representative.

4. If these two successfully pass the test, the remainder of the pipe may be accepted by the Owner's representative.

5. If either of these two pipes fails to pass the test, the balance of the pipe cannot be accepted unless each pipe successfully passes the test.

B. Pipe Joints

1. Bell and Spigot. Bell and spigot joints shall conform to ANSI/AWWA C301, “Prestressed Concrete Pressure Pipe, Steel Cylinder Type.” Protect the joint rings from corrosion by spray coating with metallic zinc to a minimum thickness of 4 mils.

2. Grooved and Shouldered. Connect valves by means of grooved and shouldered couplings. The grooved and shouldered couplings shall be Victaulic Style 44, fabricated of corrosion resistant materials.

3. Restrained.

a. Restrained joints shall provide a flexible tied joint.

b. Acceptable devices would be a clamp type harnessed joint or snap ring restrained joint as manufactured by Price Brothers Company, or equal.

c. Restrained joints shall be capable of withstanding the combined working and surge pressure.

d. When a metallic restrained joint is specifically called for, protect all steel parts of the restrained joint from corrosion by spray coating with metallic zinc to a minimum thickness of 4 mils.

PART 3 EXECUTION

3.1 **INSTALLATION.** In accordance with Section 33 05 30, "Pressure Pipe, Fittings and Valves, Installation."

A. All recommendations in accordance with AWWA M9 shall be followed for installation, delivery, and storage of pipe materials.

B. Pipe and Valve Installation

1. Gaskets.

a. Place rubber gaskets in a container containing a vegetable soap mixture.

b. When the pipe is lowered half way into the trench, clean the spigot ring thoroughly, including the gasket groove, and a soaped gasket installed into the groove, making sure the gasket is lightly covered with soap after installation.

c. At the same time, clean and lightly soap the steel bell ring of the pipe into which the spigot is to be inserted.

2. Jointing.

a. Lower the pipe into the trench, making sure that no dirt touches the soaped areas.

b. As the joint is shoved home, check the gasket with a feeler gauge from the inside or the outside as recommended by the pipe manufacturer.

c. If any irregularity is found, take the joint apart and make again as specified above using a new gasket.

3. Alignment. If changes in alignment and grade are required, "crack" or open the joint no more than the amount shown in the approved layout schedule.

4. Mortar Joint.

a. After several lengths of pipe have been laid, complete the joints by grouting the outside joint recess.

b. The grout shall be one-part Portland cement (ASTM C 150 Type 1 or Type 2) to two parts concrete sand and sufficient water to give the mixture the consistency of thick cream.

c. Furnish a cloth-form diaper and straps from the pipe manufacturer for use in retaining the outside joint grout.

d. After the joint has been poured with the thin grout, trowel a stiffer mortar mixture over the joint.

3.2 FIELD QUALITY CONTROL

A. Refer to Specification Sections 01 89 19, “Leakage Test and Disinfection” and 33 05 30, Pressure Pipe Fittings Valves Installation” for requirements.

END OF SECTION

SECTION 33 05 40

SEWER PIPE, INSTALLATION

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK.** Provide the labor, tools, equipment, and materials necessary to install the pipe in accordance with the drawings and specifications. The work includes, but is not limited to, the following:

1. Excavation, preparation of the trench bottom, bedding, and backfilling.
2. Piping work beginning at the outside face of structures or building foundations, unless specifically included under other sections.
3. Pipe beneath structures.
4. Shoring, bracing, and dewatering.
5. Work on existing buried pipelines.
6. Testing for leakage and displacement inspection.
7. Disposal of all excess material.
8. Cleaning.
9. Trench maintenance.

1.3 **QUALITY ASSURANCE**

A. **Standards**. Conform all materials and workmanship with the following standards:

1. AASHTO – American Association of State Highway and Transportation Officials.
2. ASTM – American Society for Testing and Materials.

B. **Trench Maintenance**

1. Be responsible for the condition of the trenches for 1 year after final acceptance.
2. The year must include the period November 1 to April 30 of the following year.
3. Extend the contract bond to cover the entire trench maintenance period.

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and this specification section.

A. **Submittal Package No. 1 – Backfill Product Data**

1. Product Data. Material data, noting each material source, location, sieve analysis, and other information which will show that the source and supplier are capable of furnishing materials meeting the requirements of

these specifications. Submit name and location of all borrow pits. Product data is required for the following:

a. Granular pipe bedding.
b. Granular backfill.

1.5 **JOB CONDITIONS**. Provide all water required for testing at no additional cost to the Owner.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**

1. Deliver, store, and handle in accordance with Section 01 60 00, "Materials and Equipment."
2. Pipe, fittings, and accessories that are cracked, damaged, or in poor condition, or have damaged linings will be rejected.
3. Pipe handled on skidways shall not be skidded or rolled against other pipe.
4. Protect PVC or PE pipe from exposure to heat or direct sunlight (ultraviolet rays).

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **GENERAL**

A. **Pipe and Fittings**. Conform all buried piping, fittings, and joints to the drawings and requirements specified in the corresponding section for each type of pipe installed.

B. **Manufacturer**

1. All new buried piping of one material shall be by a single manufacturer.
2. All buried fittings of one material shall be by a single manufacturer.
3. All pipe and fittings manufactured outside the United States shall be certified to ISO 9001:2000 standards for quality assurance.

C. **Identification**. Paint or cast all pipe and fittings with the pipe size, material, and class or schedule on the exterior pipe surface.

D. Site Observation.

1. Pipe and fittings will be observed by the Engineer/Architect or their authorized representative prior to installation.
2. Remove all rejected or damaged pieces from the project.
3. Substitute acceptable pipe for rejected or damaged pieces at the Contractor's expense.

2.2 BACKFILL

A. **Granular Pipe Bedding**.

1. Crushed stone or gravel meeting the following requirements:

Nominal Pipe Size	AASHTO M43 Size
Less than 16 "	7, 78, 8, or 89
Greater than 16"	6, 67, or 68

2. Maximum loss during an AASHTO T104 5-cycle sulfate soundness test shall be 15 percent.
3. Maximum wear during an AASHTO T-96 Los Angeles abrasion test shall be 50 percent.

B. **Selected Excavated Trench Material**. Free from cinders, refuse, organic material, boulders, rocks, frozen material, or other material which in the opinion of the Engineer is unsuitable.

C. **Excavated Trench Material**. Free from frozen earth, debris, or earth with an exceptionally high void content.

D. **Granular Backfill**.

1. Granular backfill materials shall be gravel, crushed gravel, crushed stone, or sand meeting the following grading requirements:

Sieve	Total Percent Passing
2-1/2 inch	100
1 inch	70 – 100
No. 4 (3/16 inch)	25 – 100
No. 40	10 – 50
No. 200	5 – 15

2. The fraction passing a No. 40 sieve shall have a liquid limit not greater than 30 and a plasticity index not greater than 6.
3. Maximum loss during an AASHTO T104 5-cycle sulfate soundness test shall be 15 percent.
4. Maximum wear during an AASHTO T-96 Los Angeles abrasion test shall be 50 percent.

2.3 WYE, RISER, AND HOUSE SERVICE MATERIALS

A. **Service Material**. The house service pipe, riser pipe, cleanout, and connection to the main sewer shall be of the same material, strength, and joint as the main sewer, unless shown or approved otherwise. Specifications for sewer pipe and joints are applicable for all house services.

B. **Wye Poles**. Wye poles shall be of hardwood, not less that 2" x 2" in cross section. The material used for wye poles shall be in good condition and shall be straight, sound, and free from large or loose knots.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verify the location**, line, and grade of the sewer trench.

B. **Confirm that all conditions** are acceptable to begin construction of the work covered in this specification.

C. **Coordinate with other construction** or facility operations activity at the same facility or area.

3.2 PREPARATION

A. **Safety**. For the security and safety of persons in and adjacent to trenches or construction operations, follow the safety regulations of the appropriate federal, state, and local agency.

B. **Dewatering**

1. Should water be encountered, furnish and operate suitable pumping equipment of adequate capacity to dewater the trench.
2. Dewater the trench so that the laying and joining of the pipe is made in the dry.
3. Convey all trench water in accordance with the requirements contained in the National Pollutant Discharge Elimination System (NPDES) program.
4. Convey all trench water to a natural drainage channel or storm sewer without causing any property damage.

C. **Construction Equipment**. Where sewers are located in or adjacent to pavements, all backfilling and materials handling equipment shall have rubber tires. Use crawler equipment only where there is no danger of damaging pavement.

D. **Noise, Dust, and Odor Control**. Conduct construction activities to minimize all unnecessary noise, dust, and odors. Do not use oil or other material that may cause tracking for dust control.

E. **Alignment and Grade**

1. Laser Beam.

a. If using a laser beam for horizontal and vertical control of the sewer, place line and grade stakes at 25 feet and 50 feet from the downstream manhole and then at every 50-foot station to the next manhole.

b. Set up the laser unit so that the alignment of the beam is through the pipe directly on the centerline of the pipe or outside the pipe directly above and parallel to the centerline of the pipe.
c. If the laser unit is set up on the centerline of the pipe, use a blower to provide positive continuous air circulation within the pipe.
d. Establish a target on line and grade to provide a method of checking the setting of the laser beam as construction progresses.
e. Make sure that the grade pole is plumb when checking pipe grade.
f. Set the grade pole on the invert of the pipe when checking alignment and grade.

2. Batter Boards.

a. If using batter boards, place line and grade stakes at regular intervals, not to exceed 25 feet, at some convenient offset from the centerline of the pipe.
b. Carefully place batter boards immediately following the excavating equipment and maintain a continuous check on trench depth.
c. Utilize suitable equipment for measuring from a line drawn taut over the batter boards.
d. Carefully locate such a line on the centerline of the pipe.
e. Do not lay pipe unless a minimum of three batter boards is in place and checked.

3.3 INSTALLATION

A. Protection of Trees

1. Take special care to avoid damage to trees and their root systems.
2. Do not use machine excavation when, in the opinion of the Engineer/Architect, it would endanger the tree.
3. Where the line of trench falls within the limits of the limb spread, headers are required across the trench to protect the tree.
4. Conduct the operation of all equipment (particularly when employing booms), the storage of materials, and the deposition of excavation in a manner which will not injure trees, trunks, branches, or their roots unless such trees are designated for removal.

B. **Excavation and Construction Materials**. Deposit all excavated material and all construction materials used in the work so as not to endanger the work, create unnecessary annoyance to the public, or interfere with natural drainage courses. During the work, keep all material piles trimmed up and maintained in a neat, workmanlike manner.

C. **Trench Support**

1. Unsupported open cut for sewers will not be permitted where trenching may cause unnecessary damage to street pavement, trees, structures, poles, utilities, or other private or public property.
2. During the progress of the work, support the sides of the excavation by adequate and suitable sheeting, shoring, bracing, or other approved means.
3. Leave trench support material and equipment in place until backfilling operations have progressed to the point where the supports may be withdrawn without endangering property.
4. In lieu of removing all the sheeting, you may cut off the sheet 2 feet above the top of the pipe and remove the upper portion.
5. If all the sheeting is to be removed, remove it without causing damage to the pipe.
6. No sheeting, shoring, or bracing will be paid for by the Owner unless remaining in place on written order. In this case, payment will be made in accordance with the General Conditions.

D. **Trench Excavation and Bottom Preparation**

1. Trench Width. Hold trench widths to a minimum to accommodate the pipe and appurtenances. Measure the trench width at the top of the pipe barrel and conform it to the following limits:

	Earth	**Rock**
Minimum	Outside diameter of the pipe barrel plus 8 inches, i.e., 4 inches each side	Outside diameter of the pipe barrel plus 12 inches, i.e., 6 inches each side
Maximum	30 inches or the outside diameter of the pipe barrel plus 16 inches, whichever is greater	30 inches or the outside diameter of the pipe barrel plus 16 inches, whichever is greater

2. Excessive Trench Width. If for any reason the trench width exceeds the maximum trench width defined above, provide additional bedding and backfill.

3. Trench Depth. Excavate the trench to a point not less than one-fourth the nominal pipe diameter, and in no case less than 4 inches or more than 12 inches below the barrel of the pipe. Remove all loose material from the trench bottom.

4. Foundation.

    a. Build the sewers on a good foundation.
    b. If the material forming the trench bottom is not suitable for a good foundation, excavate farther and fill the same with suitable material.

c. Authorized excavation and the restoration of the foundation below the trench bottom will be paid for in accordance with the General Conditions.
d. Fill unauthorized excavation below the trench bottom with pipe bedding at no cost to the Owner.

E. **Pipe Bedding and Installation**

1. Pipe Bedding.

a. After preparation of the trench bottom, prepare a pipe bed using material meeting the requirements of paragraph 2.2.A.
b. Spread the bedding material over the full width of the trench bottom.
c. Carefully prepare the bed for the pipe both from a line and grade standpoint.
d. After the pipe is laid, aligned, and graded, bring the bedding material halfway up the pipe for the full width of the trench.
e. Place the bedding material under the lower part of the pipe by slicing under the haunches with a shovel.

2. Pipe Laying.

a. Commence pipe laying on the prepared bed from the lowest point, with the spigot ends pointing in the direction of flow.
b. Lay all pipe with ends abutting and true to line and grade.
c. Carefully center pipe so that when it is laid, it will form a sewer with a uniform invert.
d. Provide a pipe plug or bulkhead to prevent the entrance of foreign material whenever pipe laying operations are not in progress.

3. Pipe Joints.

a. Before making pipe joints, clean and dry all surfaces of the pipe to be joined.
b. Use lubricants, primers, adhesives, or other jointing materials as recommended by the pipe or joint manufacturer.
c. Place, fit, join, and adjust the pipe to obtain the degree of watertightness required.
d. Remove and relay pipe previously laid that is subsequently disturbed.

F. **Backfilling**

1. Initial Backfill.

a. Backfill all trench excavations immediately after pipe is laid.
b. Use bedding material meeting the requirements of paragraph 2.2.A to backfill the trench from the bedding to a level of 12 inches over the top of the pipe barrel.

c. In lieu of the above described method, you may use compacted selected trench material for backfill of rigid pipe and ductile iron pipe.
d. Place the selected material in uniform 6-inch loose layers and compact each layer to eliminate the possibility of settlement, pipe misalignment, or damage to joints.
e. In lieu of the above described methods, you may use granular backfill.

2. Final Trench Backfill.

a. From 12 inches above the pipe barrel to the surface, use excavated trench material as backfill material.
b. Do not use material for backfill that contains frozen earth, debris, or earth with an exceptionally high void content.
c. Place backfill in such a manner that the material does not free fall, but will flow onto the previously placed material.
d. Consolidate the backfill to ensure the minimum possible settlement and the least interference with traffic.
e. Do not use mechanical equipment such as wheeled vehicles to compact backfill unless sufficient cover is provided over the pipe to prevent damage to the pipe.
f. When backfilling under pavements or driveways, use granular backfill material in place of the excavated material specified in paragraphs 3.3 F.1 and F.2.

G. **River Crossing**

1. General. It is the intent of the drawings and specifications to install the crossing in a manner that protects the sewer from erosion and restores, as much as practicable, the riverbanks and bottom to their original condition.

2. Sewer Protection. Protect the sewer from erosion either by concrete encasement around the pipe or by a sufficient depth of compacted backfill as shown.

3. Riverbank Restoration and Protection.

a. Restore the riverbanks by backfilling the trench with mechanically compacted earth to the original ground surface.
b. Extend the limits of compaction as shown.
c. Following completion of the river crossing, place straw bales along the riverbank within 2 feet of the edge of water on both sides and of sufficient length to extend beyond the limits of the excavated trench width.
d. Leave straw bales in place until after the riverbanks have been fine-graded, fertilized, and seeded, and until such time as the seeding has sufficiently grown to protect the riverbanks from erosion.

4. River Bottom Restoration. Backfill the river bottom trench with mechanically compacted earth.

5. Construction Procedure. Use either of the following methods to install the river crossing.

a. Option 1.

1) Construct an earth embankment from the riverbank to a point beyond the centerline of the river.
2) Protect the slopes of the earth embankment shall be protected from erosion by covering them with 6-mil polyethylene sheeting.
3) Extend the sheeting from the river bottom to an elevation 2 feet above the water level.
4) Install the main in a trench excavated through the embankment.
5) Remove the embankment and any excess trench material off-site.
6) Use the same procedure to install the remainder of the river crossing.

b. Option 2.

1) Construct a cofferdam of sandbags or inflatable bags from the riverbank to a point beyond the centerline of the river.
2) Install the main in a trench within the cofferdam.
3) Remove any excess trench material off-site.
4) Remove the cofferdam.
5) Use the same procedure to install the remainder of the river crossing.

H. **Wye, Riser, and House Service**

1. Description. Furnish and install the wye (or tee) branches, riser pipe, house service, and incidentals where shown, where directed, and as specified herein.

2. Wye Branches. Wye branches shall be of the proper size.

a. Location. In general, place wye branches in the main sewer opposite each lot or property to which a house service may be extended.
b. Existing Sewers. Where a wye branch is to be installed in an existing sewer, tap the sewer pipe and install the wye branch as directed.

3. Riser Pipe. Where the cover on the wye branch is in excess of 12 feet below average ground surface, add a 45-degree bend and sufficient rise pipe to terminate (to the nearest even length of riser pipe) at a depth of 10 feet below the ground surface unless shown otherwise.

4. House Services.

   a. House services to be extended from main sewers over 10 feet deep, where the property being served does not require the full depth, may be brought up to grade in the manner described for riser pipe with payment for all pipe as house service only.

   b. House services from main sewers with less than 10-foot depth will be extended on a straight uniform grade from the main to the point of terminus.

   c. The minimum depth of house services at the point of termination shall be 8 feet unless shown otherwise.

   d. Specifications for sewer pipe installation are applicable for all house services.

   e. Unless otherwise shown or directed, install all house services in a trench with a maximum width at the top of the pipe barrel of 24 inches.

   f. Encasement Pipe.

      1) At the location shown or as directed, install house services in an encasement pipe as shown.
      2) Excavate a sufficiently large boring pit to allow for proper alignment of the drilling equipment and the house service pipe to be pushed through the encasement pipe.
      3) The horizontal alignment of the encasement pipe shall not vary more than 2 feet at the upstream end of the house service from a line drawn at right angles to the sanitary sewer at the wye branch or riser.

5. Closures.

   a. Securely seal the outlet of each wye branch, riser, or house service with a watertight closure that can be later removed without damage to the outlet.

   b. This closure shall be capable of withstanding the test pressures specified for the main sewer and house services.

   c. Polyvinyl Chloride (PVC).

      1) Make all closures at the ends of PVC wye branches, risers, or house services by installing a length of PVC pipe to the wye branch, riser, or house service and installing a PVC cap or plug to the end.
      2) Install a sufficient length of pipe to permit removal of the closure and extending the line in the future.
      3) All closures shall have elastomeric gasket joints.

6. Wye Poles.

a. Place a wye pole at the end of each wye branch, riser, or house service, extending to a point 6 inches below finished grade.
b. Brace the wye pole to hold it firmly in position during backfilling.
c. If the wye pole is pulled out, bent, or broken, replace or straighten the pole.
d. The wye pole shall be adjacent to the end of the pipe, but not in it.
e. Record and submit the location of each wye pole.

3.4 FIELD QUALITY CONTROL

A. Leakage Test

1. See Section 01 89 19, "Leakage Test and Disinfection."
2. A minimum of four sections of sewer (one section defined as the sewer between two successive manholes) will be permitted to remain untested at any time.
3. Storm sewers will not require leakage tests unless shown or specified otherwise.

B. Displacement Inspection

1. After other required tests have been performed and the trench backfill completed above the top of the pipe to the finished grade surface and a minimum of 30 days has elapsed, inspect the pipe to determine whether any displacement has occurred.
2. Conduct this inspection in the presence of the Engineer/Architect.
3. Enter and examine pipe sizes larger than 36 inches, and inspect smaller-diameter pipe by shining a light between manholes or manhole locations, or by the use of television cameras passed through the pipe.
4. If the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, redo the leakage test and remedy any defects as directed at no additional cost to the Owner.

3.5 DEMONSTRATION

A. **Visual**. With Owner, and/or Engineer/Architect, visually review the sewer installation for completion. Demonstrate that all sewer materials and appurtenances are in conformance with the Contract Documents.

B. Deflection

1. Before final acceptance of completed thermoplastic sewer lines, perform a pipe deflection test on all main line sanitary and storm sewers.

2. Measure all lines for vertical ring deflection no sooner than 30 days after completion of backfilling operations, provided sufficient settlement of the backfill has occurred.

3. The Engineer will be the sole judge as to when sufficient settlement has occurred.

4. The maximum limit of vertical deflection shall not exceed 5 percent of the inside diameter of the pipe as presented in Appendix XI of ASTM D-3034, "Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings."

5. Accomplish the test by manually pulling an approved "go, no-go" mandrel with nine arms.

6. Provide all equipment and labor, including mandrel, to perform and conduct the required test.

7. Notify the Owner at least 48 hours in advance of the anticipated date of the testing for scheduling of personnel needed to monitor the testing operations.

8. In areas where deflections exceed the 5 percent limit, correct the problem areas by one of the following procedures at no additional expense to the Owner:

    a. Procedure 1. Replace the failed pipe in accordance with the original plans and specifications.

    b. Procedure 2.

        1) Reround all failed sections by means of an internal pneumatic vibratory compactor, performed by an approved company providing this service.
        2) Submit methods, types of equipment, and qualifications of company to provide service in writing for approval at least 5 working days in advance of performing this procedure.
        3) This method may be used only if approved and it is determined that the deflection has not exceeded 10 percent of the base inside diameter of the pipe, by pulling a 9 arm "go, no-go" mandrel having a diameter equal to 90 percent of the base inside diameter of the pipe.

    c. After completing either Procedure 1 or 2, retest the repaired area(s) for leakage and deflection as specified herein before final acceptance.

C. **Final Acceptance**. The visual demonstration will not be considered as final acceptance of the work. Correct all and any discrepancies "punch listed" at final inspection to the satisfaction of the Engineer/Architect and Owner.

3.6 **CLEANING**. After a section of sewer is tested and accepted, clean the ground surface of all surplus material including stone, broken pipe, and construction material to the satisfaction of the Engineer/Architect.

3.7 **PROTECTION**. Protect the sewer appurtenances (such as manholes and wye poles) from damage during subsequent construction operations. Remove any and all protection at the completion of the project.

END OF SECTION

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SECTION 33 05 42

CONCRETE SEWER PIPE

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Section 33 05 40, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the concrete sanitary or storm sewer pipe in accordance with the plans and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 33 05 40, "Sewer Pipe, Installation."

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings, Certifications, and Test Reports**

1. Shop Drawings. Detailed plan and profile drawings for all piping showing full details of piping, specials, and connections to existing pipes and structures.
2. Certifications. Certification of compliance with the referenced standards.
3. Test Reports. Description of proposed testing methods, procedures, and apparatus.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 33 05 40, "Sewer Pipe, Installation."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Concrete Pipe**

1. Concrete sewer pipe and fittings shall meet the requirements of American Society for Testing and Materials (ASTM) C 76, "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe," Wall B, or Wall C.

2. Elliptical cage circumferential reinforcement will not be accepted. Horizontal elliptical concrete sewer pipe shall meet the requirements of ASTM C 507.

B. **Sanitary Sewer Pipe Joints**. Concrete sanitary sewer pipe joints shall be flexible, watertight joints conforming to ASTM C 443, "Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets."

C. **Storm Sewer Pipe Joints**. Concrete sewer pipe joints shall conform to one of the following joints. Furnish evidence of satisfactory performance of the joint to be installed from previous installations.

1. Flexible Joints. Flexible joints shall conform to ASTM C 443. Provide all equipment necessary to conduct the pipe joint tests.

2. Bituminous Pipe Joint Filler.

   a. Use an approved bituminous plastic cement in sufficient quantity to fill the joint when the pipe has been placed in position.
   b. After the pipe has been set to its true alignment and grade, remove all surplus material from the inside of the pipe.
   c. If bell-and-spigot pipe is used, place and properly caulk a gasket of jute in the joint and maintain alignment of the pipe.

3. Cement Mortar Joints, Bell and Spigot.

   a. Place and distribute a stiff Portland cement mortar mixed in the proportion of one part cement to two parts sand around the lower 1/8 of the circumference of the bell.
   b. In this mortar, bed one or more strands of dry, twisted jute, previously saturated with neat cement mortar, and of a proper length to encircle the pipe and lap ends.
   c. Insert the spigot end of the pipe in the bell, taking care to avoid displacement of the jute or mortar, until the spigot is fully home to the shoulder of the pipe.
   d. Drive the jute into the bell of the pipe around the spigot with suitable yarning iron.
   e. Completely fill the joint with stiff mortar, as specified above, applied with a rubber mitten and pushed into the joint until the socket is completely full.
   f. Furnish the joints with a suitable mortar bevel.
   g. Scrape the interior of each joint clean of all projecting mortar, and use an approved follower or scraper to accomplish this to the satisfaction of the Engineer/Architect.
   h. After the pipe is graded and aligned and the joint is made, no walking on the pipe will be permitted until the backfill has been carefully placed and tamped to 6 inches above the pipe.
   i. Use every precaution to prevent disturbance of the joint after it is completed.

4. Precast Joints.

a. Make precast joints with an approved die-cast, tapered-type joint, which shall be made by fitting the spigot and socket of the pipe with collars of bituminous compound.
b. The compound shall have a melting point of 240 to 270 degrees Fahrenheit (°F.) and a penetration of 4 to 7 at 77° F.
c. Die-cast a lining or ring of this jointing material into the socket of the pipe.
d. Fit the spigot with a collar of the same material die-cast around the end of the pipe, and of such size that, when shoved firmly into the socket portion of the pipe, a tight fit between the socket and the spigot end of the pipe will be made.
e. All pipe must be dry and clean when the lining and the collar are cast; pour the compound at a heat high enough to produce adhesion to the pipe.
f. Inspect all asphalted collars before the pipe is laid, and use no pipe if either collar shows any void or unfilled space.
g. No jute or other caulking material is necessary for this type of joint, and will not be permitted.
h. Just before the pipe is laid, coat the lining and the collar with a solvent which shall cause the surface to become plastic or tacky, and when the pipes are shoved firmly together, the joint material shall unite and, incidental to diffusion of the solvent, congeal and become one homogeneous body.

PART 3 - EXECUTION. In accordance with Section 33 05 40, “Sewer Pipe, Installation.”

END OF SECTION

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SECTION 33 05 43

DUCTILE IRON SEWER PIPE

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Section 33 05 40, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the ductile iron sanitary sewer pipe in accordance with the plans and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 33 05 40, "Sewer Pipe, Installation."

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings, Certifications, and Test Reports**

1. Shop Drawings. Detailed plans and profile drawings for all piping showing full details of piping, specials, and connections to existing pipes and structures.
2. Certifications. Certification of compliance with the referenced standards.
3. Test Reports. Description of proposed testing methods, procedures, and apparatus.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 33 05 40, "Sewer Pipe, Installation."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Ductile Iron Pipe**. Ductile iron sewer pipe in accordance with the American National Standard Institute/American Water Works Association (ANSI/AWWA) C151/A21.51.

1. Material. The chemical constituents shall meet the physical property recommendations of ASTM A 536 to ensure that the iron is suitable for satisfactory drilling and cutting.
2. Coating and Lining. Coat the exterior of the pipe with a bituminous coating in accordance with ANSI/AWWA C151/A21.51 and the interior with cement mortar and asphaltic seal in accordance with ANSI/AWWA C104/A21.4.

3. Joints. Provide the pipe with either push-on or mechanical joints in accordance with ANSI/AWWA C111/A21.11. Bolts shall be high strength cast iron tee head with hex nuts.

B. **Fittings**. Cast or ductile iron fittings shall be a minimum Class 150 with either mechanical or push-on joints in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA 153/A21.53. Coat and line fittings as specified for ductile iron pipe.

C. **Connections**. Connections to different sewer pipe materials as shown or with approved adapters or couplings.

D. **Cutting**. When cutting pipe, leave a smooth end at right angles to the axis of the pipe.

PART 3 - EXECUTION. In accordance with Section 33 05 40, "Sewer Pipe, Installation."

END OF SECTION

SECTION 33 05 44

HIGH-DENSITY POLYETHYLENE SEWER PIPE

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the high-density polyethylene (HDPE) sanitary or storm sewer pipe in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 33 05 40, "Sewer Pipe, Installation."

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings, Certifications, and Test Reports**

1. Shop Drawings. Detailed plan and profile drawings for all piping showing full details of piping, specials, and connections to existing pipes and structures.
2. Certifications. Certification of compliance with the referenced standards.
3. Test Reports. Description of proposed testing methods, procedures, and apparatus.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 33 05 40, "Sewer Pipe, Installation."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **HDPE Profile Wall Pipe**

1. PE Pipe. HDPE pipe shall conform to American Society for Testing and Materials (ASTM) F 894.

2. PE Plastics. PE plastic shall conform to ASTM D 1248. They shall be made of PE resins classified Type III, Category 5, Grade P34.

a. Resin. PE resins shall contain antioxidants and carbon black.

b. Stress Cracking. PE resin compounds shall have a resistance to environmental stress cracking as determined by the procedure detailed in ASTM D 1693 Condition C with sample preparation by Procedure C of ASTM D 1928 for not less than 200 hours.

c. Virgin Material. All pipe shall be made from virgin material or from rework compound obtained from the manufacturer's own production of the same formulation.

d. Homogeneous. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other faults.

3. Pipe and Fittings. Pipe and fittings shall meet the requirements of ASTM D 3350.

4. Fittings. Provide factory-made HDPE fittings with joints of proper design or approved adapters to connect the pipe to the fittings. Provide adapters for connection to pipes of different materials.

5. All pipe spigots shall have a “home” mark to facilitate joint closure.

B. **Pipe Joints**. HDPE sewer pipe joints shall be elastomerically gasketed conforming to ASTM F 894. Thermal-welding of the joints will not be accepted.

C. **Exposure to Sunlight**. Take care to protect PE pipe from prolonged exposure to heat or direct sunlight (ultraviolet rays).

PART 3 - **EXECUTION**

3.1 **INSTALLATION**. Install pipe in accordance with Section 33 05 40, "Sewer Pipe, Installation."

END OF SECTION

SECTION 33 12 16

BURIED VALVES

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the buried valves in accordance with the plans and specifications.

1.3 **QUALITY ASSURANCE**. Materials and workmanship shall be in accordance with the following standards as referenced herein.

A. **AWWA** – American Water Works Association.

B. **ASTM** – American Society for Testing and Materials.

1.4 **SUBMITTALS**

A. **General.** Submit all required documents and materials in accordance with Section 01 33 00 and this section.

B. **The following submittal content and schedule requirements** are required to be submitted when indicated by the individual valve specifications.

1. Shop Drawings and Product Data.

a. Schedule. No other submittal packages related to this equipment can be approved before this one.

b. Submittal Package Contents.

1) Manufacturer's name.
2) Body, seating, and trim materials.
3) Dimensions.
4) Connection details.
5) Required clearances.
6) Parts list with materials and part numbers for the valves and accessories.
7) Maximum operating pressure and temperature ratings.
8) Manufacturer's instructions.
9) Certificate of compliance and proof of design with AWWA standards.

2. Operation and Maintenance (O&M) Manuals.

a. Schedule. Submit the initial review copy of the O&M manual and the revised copies prior to delivery of the equipment.
b. Submittal Package Requirements. O&M manuals in accordance with Section 01 33 00.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING** (Not used)

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **BURIED VALVES**

A. **Resilient Wedge Gate Valves**

1. Manufacturer. Subject to compliance with the specifications, provide the resilient wedge gate valves from one of the following approved manufacturers.

a. American Flow Control (2 inches – 48 inches).
b. McWane Inc. including Clow, Kennedy, American R/D, and M&H Valve Company (2 inches – 48 inches).
c. American AVK (2 inches – 24 inches).
d. Mueller (2 inches – 48 inches).
e. US Hydrant and Valve (2 inches – 48 inches).

2. Performance.

a. All resilient wedge gate valves, for whatever service, shall be capable of passing "pigging" cleaning equipment in either direction and without the use of special equipment.

b. Valve Design Pressure.

1) Shut off bubble tight at 250 pounds per square inch (psi).
2) Each valve shall be given a bidirectional hydrostatic seat test with the test results being certified by the manufacturer.

3. Materials.

Part	Material
Valve Body	Cast or ductile iron
Wedges	ASTM A 536, Grade 65-45-12 high-strength ductile iron or one-piece A 126 cast iron; completely encapsulated with permanently bonded SBR or EPDM rubber.
Nuts and Bolts	Type 316 Stainless Steel
Stem and Stem Nuts	Bronze

4. Fabrication and Assembly.

   a. In accordance with AWWA C509 or C515.
   b. Nonrising stems.
   c. Valve stem seals shall be three O-rings.
   d. Packing arrangement shall utilize two sets of packing.
   e. Furnished with two low-torque thrust bearings.

B. **Butterfly Valves**. Butterfly valves shall conform to AWWA C504, except as modified herein.

1. Body. The valves shall be AWWA Class 150B designed for tight shutoff against a differential pressure of 150 psi. Valve bodies shall be constructed of cast iron, American Society for Testing and Materials (ASTM) A 126, Class B. Two trunnions for shaft bearings shall be integral with the valve body. The valves and all appurtenances shall be suitable for buried service.

2. Ends. Valves shall have mechanical joint ends and shall be furnished with high strength cast iron tee head bolts and hex nuts, cast iron glands, and rubber gaskets for each mechanical joint end.

3. Discs. Valve discs of cast steel, fabricated steel, or cast bronze are not acceptable.

4. Seats. Seats bonded on the discs are not acceptable.

5. Shaft Seals. If stuffing boxes are utilized for shaft seals they shall be constructed of cast iron, ASTM A 126. Gland assemblies shall be of cast bronze, ASTM B 132. The packing gland shall be housed in a solid walled cast iron, ASTM A 48, Class 40 one-piece structure or equal.

6. Operators. The valve operating mechanisms shall be for counterclockwise opening. There shall be no external moving parts on valve or operator except the operator input shaft. Input shaft is to be operated by a 2-inch square operating nut. Maximum required input force on the operator shaft to open and close the valve shall be 40

pounds. The total number of turns applied to the operating nut required to completely open the valve from a completely closed position shall be not less than twice the nominal valve diameter. An extension stem shall be furnished if required to bring the operating nut within 3 1/2 feet of finished grade. Extension stems shall be securely fastened to the valve stem. A stainless steel collar, 6 inches high, shall be welded to the operating gear box housing centered on the operating nut to hold the valve box in place and seal it against dirt. The diameter of the collar shall be such that it will accept the valve box.

C. **Full Port Plug Valves**

1. Manufacturer. Subject to compliance with the specifications, provide the full port plug valves from one of the following approved manufacturers.

   a. Clow/M&H (3 inches – 24 inches).
   b. DeZurik (1/2 inch – 72 inches).
   c. Milliken (2-1/2 inches – 72 inches).
   d. Pratt (1/2 inch – 36 inches).
   e. Val-Matic (1/2 inch – 36 inches).

2. Performance.

   a. All plug valves, for whatever service, shall be capable of passing "pigging" cleaning equipment in either direction and without the use of special equipment.

   b. Valve Design Pressure.

      1) 12 Inches and Under. 175 pounds per square inch (psi).
      2) 14 Inches through 36 Inches. 150 psi.
      3) 42 Inches and Larger. 125psi.

   c. Valve Capacity.

      1) Full Port Plug Valves. Port clear areas shall be a minimum of 100 percent port.

3. Materials.

Part	Material
Body	ASTM* A 126, Class B cast iron or ASTM A 536 ductile iron
Seat Overlay	Not less than 90% nickel or Type 316 stainless steel
Plugs	One-piece ductile or cast iron
Sealing Surface	BUNA-N or chloroprene
Grit Seals	PTFE

*ASTM – American Society for Testing and Materials

4. Fabrication and Assembly.

   a. In accordance with AWWA C517.
   b. Nonrising stems.
   c. Dual "U" cup type in accordance with AWWA C517-05, Section 4.4.7 or a multiple V-ring and installed on the upper and lower plug shafts.
   d. Packing arrangement shall utilize two sets of packing.
   e. Furnished with two low-torque thrust bearings.

D. **Tapping Sleeves and Valves**. Design tapping sleeves and valves for a working pressure of 150 psi. Test the tapping sleeve together with the tapping valve at 150 psi for visible leakage before the main is tapped.

1. Tapping Sleeves. Tapping sleeves shall be two-piece with either caulk-type or mechanical-joint-type ends, and be so designed as to assure uniform gasket pressure and permit centering of the sleeve on the pipe.
2. Tapping Valves. Tapping valves shall have a flange on one end for bolting to the tapping sleeve and a mechanical joint type end connection on the outlet with slotted standard flange or other adapters for connection to the tapping machine. The valves shall open by turning counterclockwise. Tapping valves shall conform to AWWA C500 except that the seat rings shall be oversized to permit entry of the tapping machine cutter.

E. **Valve Boxes**. Provide all buried valves with valve boxes. Valve boxes shall be of standard, adjustable, heavy pattern, cast iron extension type, three piece, 5-1/4-inch shaft, screw type, and of such length as necessary to extend from valve to finished grade. Set tops at established grade, and the valve box cover marked with either "water" or "sewer" as applicable.

Valve Size	Base
4" and smaller	Round, 8" in height, 10-7/8" diameter at bottom
6" and 8"	Round, 11" in height, 14-3/8" diameter at bottom
10" through 16"	Oval, 9-1/2" in height, 21" by 12-1/2" diameter at bottom
18" and 20"	Oval, 10" in height, 25-1/2" by 16" diameter at bottom
24"	Dome, 5" in height, 15" diameter, and 17" flange at bottom

F. **Valve Wrench**. Provide a valve wrench of sufficient length shall be provided for every five valves or less furnished.

PART 3 - EXECUTION

3.1 **INSTALLATION**. In accordance with Section 33 05 30, "Pressure Pipe, Fittings, and Valves."

END OF SECTION

SECTION 33 12 19

FIRE HYDRANTS

PART 1 – GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Section 33 05 30, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the fire hydrants in accordance with the plans and the specifications.

1.3 **QUALITY ASSURANCE**. Material and workmanship shall be in accordance with the following standards:

A. **American National Standards Institute**. ANSI.

B. **American Water Works Association**. AWWA.

1.4 **SUBMITTALS**. Submit the following submittal package in accordance with the Division 1 Submittal Requirements.

A. **Submittal Package No. 1 – Product Data**

1. Schedule. No fire hydrants shall be delivered to the site until this package has been approved.
2. Submittal Package Contents. Product data.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 01 60 00, "Materials and Equipment."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 – PRODUCTS

2.1 **MATERIALS**

A. **Fire Hydrants**

1. Conform to ANSI/AWWA C502, "Dry-Barrel Fire Hydrants."
2. The hydrants shall have a 6-inch mechanical joint inlet connection, a 4-1/4-inch main valve opening, two 2-1/2-inch hose nozzles and one 4-1/2 inch pumper nozzle. All outlet nozzles shall have National (American) Standard threads.
3. Furnish with a 5-foot bury length.
4. Operating Nut. 1-1/2-inch pentagon.

5. Traffic-rated and self-draining.
6. Direction of Opening. Counterclockwise.
7. Color shall be hydrant yellow unless noted or directed otherwise.
8. 250-pound-per-square-inch (psi) maximum working pressure.
9. 500-psi minimum static test pressure.
10. Furnish hydrants complete with hydrant cap chains for all nozzles.
11. Subject to compliance with the specifications, all hydrants must be from one of the following approved manufacturers.

    a. American Darling B-84-B.

B. **Hydrant Wrench**. Provide one 15-inch-long hydrant wrench with each five fire hydrants or fewer furnished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Setting Hydrants**

1. Locate hydrants as shown on the plans or as directed.
2. The location shall provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.
3. Pumper nozzle shall be placed perpendicular to the roadway.
4. When placed behind the curb, set the hydrant barrel so that no portion of the pumper or hose nozzle cap will be less than 12 inches from the gutter face of the curb.
5. Stand all hydrants plumb with the pumper nozzle facing the curb.
6. Set hydrants having two hose nozzles 90 degrees apart with each nozzle facing the curb at an angle of 45 degrees.
7. Set hydrants to the established grade, with nozzles at 12 inches above the ground.
8. Unless otherwise shown, connect each hydrant to the main with a 6-inch branch connection controlled by an independent 6-inch gate valve.

B. **Sump**

1. Excavate a sump 2 feet in diameter and 2 feet deep below each hydrant.
2. Fill sump with granular pipe bedding; compact under and around the shoe of the hydrant and to a level of 6 inches above the waste opening.
3. Do not connect any drainage sump to a sanitary sewer.

C. **Laying, Backfill, and Anchoring**. In accordance with Section 33 05 30, “Pressure Pipe, Fittings, and Valves, Installation,” and the drawings.

END OF SECTION

SECTION 33 56 13

DIESEL FUEL ABOVEGROUND STORAGE TANK SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **All material and installation sections** relating to site preparation, painting, concrete and other related work not specified herein are covered in appropriate sections of these specifications.

1.2 DESCRIPTION OF WORK

A. **This section describes requirements for providing** the equipment, labor, and materials necessary to furnish and install aboveground petroleum storage tank system utilizing a 2-hour fire-rated aboveground steel tank with concrete encasement.

B. **Requirements include furnishing and installing** all equipment and accessories necessary to make complete systems for the storage and dispensing of diesel fuel.

C. **Unless otherwise specified**, equipment furnished under this section shall be fabricated and installed in compliance with the instructions of the manufacturer.

D. **Ensure that all equipment**, accessories, and installation materials comply with the specification and that adequate provision is made in the tank design and fabrication for mounting the specified system equipment and accessories.

E. **Be solely responsible** for construction means, methods, techniques, sequences, and procedures and for safety precautions and programs.

F. **Provide all labor, equipment**, and material required to provide a complete and functional system.

G. **To avoid delays in construction**, ensure that all components of the system are available at the time of installation.

H. **Coordinate work with other work** being performed at the construction site and minimize interference with the Owner's normal activities which may continue during construction.

I. **Obtain necessary permits**, arrange for inspections, and obtain approval of the appropriate authority having jurisdiction over the work described.

1.3 QUALITY ASSURANCE

A. **The manufacture and installation** of aboveground storage tank systems described in this section shall adhere to the following standards and regulatory requirements.

1. Standard for Insulated Secondary Containment – Protected Type Aboveground Storage Tanks, Standard Underwriters' Laboratories, Inc. (UL) 2085; Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids, Standard UL 142; Control Equipment for Use with Flammable Liquid Dispensing Devices, UL 1238; Pipe Connectors for Flammable and Combustible Liquids and LP-Gas, UL 567; Power-Operated Dispensing Devices for Petroleum Products, UL 87; Valves for Flammable Fluids, UL 842; UL Listed Non-Metal Pipe, UL 971;

Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, Illinois 60062. (847) 272-8800.

2. Protected Aboveground Tanks for Motor Vehicle Fuel-Dispensing Stations Outside Buildings, Appendix II-F, Uniform Fire Code, 1997, International Fire Code Institute.

3. Standard for Thermally Insulated Aboveground Storage Tanks, F941; Fireguard Installation & Testing Instructions for Thermally Insulated, Lightweight, Double-Wall Fireguard Aboveground Storage Tanks, R942; Recommended Practice for Corrosion Protection of Undergound Piping Networks Associated with Liquid Storage and Dispensing Systems, R892; Steel Tank Institute, 570 Oakwood Road, Lake Zurich, Illinois 60047. (847) 438-8265.

4. CAN/ULC - (ORD - C 142.5), Standard for concrete encased aboveground tank assemblies for flammable and combustible liquids.

5. Flammable and Combustible Liquids Code, National Fire Protection Association (NFPA) 30, National Fire Protection Association.

6. Automotive and Marine Service Station Code, NFPA 30A, National Fire Protection Association.

7. National Electric Code, NFPA 70, National Fire Protection Association.

8. National Fire Prevention Code, Building Officials and Code Administrators (BOCA).

9. Occupational Safety and Health Standards, particularly Flammable and Combustible Liquids, 29 Code of Federal Regulations (CFR) 1910.106, Personal Protective Equipment 29 CFR 1910 Subpart I, Excavations 29 CFR 1926.650 Subpart P, U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Washington, D.C.

10. Clean Water Act and Oil Pollution Act of 1990, Spill Prevention, Control, and Countermeasure (SPCC) Plans, 40 CFR 112, 113, and 114.

11. Applicable state and local regulations and ordinances.

B. **In case of differences between building codes**, state laws, local ordinances, utility company regulations, and contract documents, the most stringent shall govern.

C. **The codes and standards listed** are the latest as of this publication. Codes and standards are continuously updated. The Contractor shall confirm the construction standard edition enforced by the authority having jurisdiction.

1.4 SUBMITTALS

A. **Provide shop drawings** of the following system components for approval before commencing construction.

1. Shop drawings of the tank by the tank manufacturer.

2. Assembly and installation drawings.

3. Fuel management system electrical drawings.

B. **Provide product data sheets** and descriptive material for major components to be provided.

1. Tank.
2. Pumps, valves, and fittings.
3. Fuel management system and accessories.

1.5 JOB CONDITIONS

A. Existing Diesel Underground Storage Tank (UST)

1. The new Aboveground Storage Tank (AST) shall be installed prior to the removal of the existing UST. The existing 2,500 gallon UST will be removed per the drawings by a UST Removal Contractor under a separate contract by the Owner/Engineer. The existing UST is regulated by the Bureau of Underground Storage Tank Regulations (BUSTR).
2. The following will be completed by Owner, Engineer, or UST Removal Contractor:
    a. All UST contents (diesel fuel) will be emptied by the Owner prior to performing the UST removal.
    b. Removal and disposal of the concrete pad will be completed by the UST Removal Contractor.
    c. Removal of the existing UST through an UST Removal Contractor and sampling as required by BUSTR's Technical Guidance Manual.
    d. Coordination of work based on the General Contractor's approved construction schedule.
    e. Handling of petroleum contaminated soil from the site. Remaining soil, if not contaminated, will be used as backfill and the existing concrete tie down pad will remain.
    f. Additional backfill will be required to complete the work and extra material shall be coordinated and provided by the Contractor. A temporary stockpile of excavated tank cavity and pipeline fill material location will be coordinated with the Contractor prior to the work.
    g. Backfilling the void remaining to 100 PCT compaction at 6" to 8" lifts.
    h. All removal permits, environmental sampling and reporting required.
3. The following will be required by the General Contractor
    a. Installation of the new Aboveground Storage Tank (AST) prior to removal of the existing UST.
    b. Coordination with the Owner and Engineer to schedule the proposed work to remove the UST.
    c. Locating and marking of all underground utilities.

d. Removal/abandonment of the existing piping from the existing UST to the Generator Room. The UST Removal Contractor will remove any piping within the limits of their excavation.

e. Provide sufficient backfill stockpile, conforming to Division 31 Specifications, for the additional material necessary to complete backfill of the void left by the UST. Location of the stockpile shall be coordinated prior to work. Compaction of the backfill will be completed by the UST Removal Contractor.

f. The Contractor shall perform restoration that includes grading and seeding work that meets the requirements of Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Not used.

1.7 SPECIAL WARRANTY

A. Provide insurance as specified.

B. **Provide the following** guarantees/warranties.

1. Equipment manufacturer's standard warranties.

2. Additional guarantees/warranties as specified.

1.8 DEFINITIONS

A. **Authority having jurisdiction is the local fire marshal**, building official, health department, electrical inspector, or other having statutory jurisdiction over the project.

B. **FRP is an abbreviation** for fiberglass-reinforced plastic.

C. **Install means the Contractor shall perform** all work required to place the equipment specified in operation, including installation, testing, calibration, and start-up.

D. **Interstitial refers to the space between** primary and secondary containment of tanks as well as containment sumps and piping.

E. **Leak mode testing refers to testing** the integrity of the tanks and in accordance with the test device manufacturer's instructions and U.S. Environmental Association (EPA) technical standards.

F. **Liquidtight means prevention of the release** of product from contained spaces into the surrounding soil or the infiltration of ground or surface water into a contained space.

G. **STI is the Steel Tank Institute**, 570 Oakwood Drive, Lake Zurich, Illinois 60047, (847) 438-8265.

1.9 CONSTRUCTION DOCUMENTATION

A. **At contract close-out, provide three sets** of the following installation instructions.

1. Tank.

B. **Provide three sets** of manufacturer's system component operation and maintenance manual instructions.

C. Provide record (as-built) drawings and photographs of the following:

1. The completed tank system in place.

D. **Provide copies of all testing** and inspection reports to the Owner prior to substantial completion.

PART 2 PRODUCTS

2.1 FIRE-RATED ABOVEGROUND STORAGE TANK(S)

A. **The storage tank shall be** Fireguard concrete encased aboveground tank for the storage of petroleum products at near atmospheric pressure. Number, size, and weight of tank shall be as follows:

1. 3,000-gallon capacity (nominal), cylindrical tank for diesel storage.
2. The primary and secondary tanks shall be manufactured in accordance with STI publication No. F941, "Standard Thermally Insulated Aboveground Storage Tanks."
3. The listed assembly shall meet the requirements for "protected" tank as defined by the Uniform Fire Code (UFC) Appendix II-F, and "fire-resistant" tanks as defined by UL including impact resistance, ballistics protection, and hose stream resistance criteria.
4. The tank shall consist of an inner steel wall, encased by lightweight thermal insulation material, and an outer steel wall.
5. The outer steel wall shall be UL 2085-listed for secondary containment and capable of providing a minimum 110 percent containment of the primary storage tank's content.
6. A legible UL 2085 label shall be affixed to the side of the aboveground storage tank(s).
7. Steel outer wall of the tank shall be coated to prolong weather resistance and to further reduce maintenance needs.
8. The storage tank and supports shall be delivered as a complete UL-listed unit.
9. The storage tanks and supports shall meet all the requirements for Seismic Zone applicable per Uniform Building Code requirements.

B. **Tank shall be designed for use** aboveground and include integral secondary containment, and thermal insulation that provides a minimum 2-hour fire rating.

1. Provide a porous, lightweight monolithic thermal insulation material in the tank's interstitial space.
2. The thermal insulating material shall allow liquid to migrate through the interstice to the monitoring point.
3. The thermal insulating material shall not be exposed to weathering and shall be protected by the concrete secondary containment outer wall.
4. Thermal insulation material shall be installed at the factory and be in accordance with American Society for Testing and Materials (ASTM) Standards C 332 and C 495.

C. **Tank shall be provided** with the following warranties.

1. 30-year limited warranty against leakage from the secondary containment tank, and failure of the primary tank caused by cracking, breakup, or collapse.

2. 30-year warranty that the tank was fabricated in accordance with requirements of UL 2085 and UL 142, aboveground storage tank manufacturing standards.

3. 1-year warranty against failure due to defective materials and workmanship for 1 year following the date of delivery of the tank to the job site.

D. **Register each tank** and serial number with STI in accordance with instructions provided by the manufacturer with the tank.

2.2 VENTING REQUIREMENTS

A. Provide one normal atmospheric vent for the primary tanks.

1. Vents may discharge upward or laterally, protected from intrusion of rain.

2. Tanks located in Stage II Vapor Recovery-mandated air quality areas shall be provided with pressure/vacuum vents.

3. Vents for tanks containing Class 1 liquids shall terminate at least 12 feet above ground level and be located at least 5 feet from building openings.

4. Vent installation shall comply with applicable sections of the fire and mechanical codes, including but not limited to NFPA 30A (2-4.5.e), NFPA 30 (2-3.5), UFC (7902.1.10), and BOCA (F-3201.1).

5. Accepted manufacturers and part numbers: OPW No. 23 or 523V.

B. Provide one emergency primary tank vent per compartment.

1. Vent size shall be determined by the tank configuration, the primary tank capacity, and the product stored.

2. Emergency venting shall comply with provisions of NFPA 30A (2-4.5.f), NFPA 30 (2-3.6), UFC (7902.2.6), and BOCA 9F-3201.1).

3. Accepted manufacturers and part numbers: Morrison No. 244I.

C. **Provide one emergency vent** for each secondary containment tank interstice.

1. The venting capacity is determined by the tank configuration, secondary tank capacity, and the product stored.

2. Emergency venting shall comply with provisions of NFPA 30A (2-4.5), NFPA 30 (2-3.6), UFC (7902.2.6) and (Appendix II-F 5.3), BOCA (F-3201.1), UL 142, and UL 2085.

3. Vents shall be located as close to the center of the tank as possible.

4. Accepted manufacturers and part numbers: Morrison No. 244I.

2.3 TANK FILLING AND OVERFILL PREVENTION COMPONENTS

A. **For tank with top fill assembly**, provide one lockable tight fill cap, adapter, fill pipe, and drop tube per tank.

1. The bottom of the fill drop tube shall be cut at a 45-degree angle with the open end facing the long dimension of the tank.

2. Terminate drop tube 6 inches from the bottom of the tank.

3. Comply with provisions of NFPA 30 (2-4.6.3 and 2-4.6.4) and UFC Appendix II-F 95.6).

B. **Provide a spill container** with cover and lockable hasp to contain product spills from the fill hose. Spill containment shall comply with UFC Appendix II-F (5.7).

1. Fill pipe spill container shall have a capacity of not less than 5 gallons.

2. Provide a means fro returning collected product to the storage tank.

C. **Provide overfill prevention equipment** which complies with the requirements of NFPA 30A (2-4.6.1) and which incorporates the following features.

1. An audible alarm which will sound when the product level in the tank has reached 90 percent of tank capacity.

2. A positive shut-off fill limiter which will stop the flow of liquid into the tank when product level reaches 95 percent of tank capacity.

3. The limiting device shall be rated to accept the fill flow rate and pressure.

4. Acceptable Manufacturers. Audible alarm, Morrison 918 clock gauge/overfill alarm; overfill prevention valve, OPW 61 F-Stop Model No. 2000.

2.4 MONITORING AND GAUGING SYSTEM

A. **Provide one mechanical tank** liquid level sight gauge per compartment.

B. **Acceptable manufacturers and model** numbers are Morrison 918 clock gauge with 419 drop tube.

2.5 PIPING

A. **Aboveground piping shall be** Schedule 40 steel pipe with standard (150-pound) malleable iron fittings.

1. Exposed piping shall be protected from exposure to outdoor conditions.

2. Low melting point materials may not be used above ground.

2.6 PUMPING EQUIPMENT, VALVES, AND FITTINGS – FUEL-DISPENSING APPLICATIONS

A. **Provide a UL-listed electric consumer pump** with meter, pulser, hose, breakaway, swivel, and automatic nozzle, mounted on the top of the tank. Assembly shall be in full accordance with NFPA 30A, UFC 5202, BOCA F-3207.

1. The dispenser and its components shall be UL listed for the purpose intended.

2. The dispenser shall comply with the requirements of NFPA 30A (4-2.5, 4-2.7), UFC (5201 and 5202) and BOCA (F-3201.1 and 3207).

3. Provide the necessary mounting parts and piping in accordance with NFPA 30 A (2-4.6.6), UFC (5201 and 5202).

4. Acceptable manufacturers: pump, Tuthill Fill-Rite Model FR701x375; pulser, OPW Fuel Management Systems Model 800F.

2.7 PUMP CONTROLS

A. **Provide electrical disconnection of all conductors** to the pump in accordance with NFPA Codes 30, 30A, and 70.

1. Locate the emergency shut-off in an accessible area, at least 20 feet but not more than 100 feet from the dispenser. Confirm the final location with the Owner prior to installation.

2. Provide a palm-type switch button that will shut off electrical power to the dispensing system.

3. The emergency shut-off shall be clearly identified with signage.

4. Emergency shut-off shall have a manual reset.

B. **Provide the electrical interface** between the key fuel management control system and the pumps, and between the key fuel management system and the telephone terminal.

C. Provide a key fuel management control system, as follows:

1. System shall match existing systems in various other Owner locations.

2. FleetKey key-operated fuel management system as manufactured by Gasboy International, Model CO6304 with internal CO5739 phone modem.

3. Provide system start-up and programming by a Gasboy-authorized service representative.

4. Provide 50 Green system keys.

PART 3 EXECUTION

3.1 GENERAL

A. Familiarity with the Site

1. Become familiar with the location of all public utility facilities and structures that may be found in the vicinity of the construction.

2. Conduct operation to avoid damage to the utilities or structures. Should any damage occur due to operations, make repairs at own expense in a manner acceptable to Owner.

3. Meet all requirements established by the agencies for utility work, as well as work affecting utilities and other government agencies.

3.2 TANK HANDLING, STORAGE, AND INSTALLATION

A. **Handle, life, store, and secure** t**anks** in accordance with the manufacturer's instructions.

B. **Unload with equipment having sufficient** lifting capacity to avoid damage to the tank. Securely store the tank at the job site.

C. **Install the tank and associated equipment** in accordance with the fire safety codes, regulations, standards, and manufacturer's instructions including:

1. Federal, state, and local fire safety, occupational health, and environmental regulations.

2. STI installation instructions for Fireguard aboveground tanks (publication No. R942, "Installation and Testing Instructions for Thermally Insulated Lightweight Double-Wall Fireguard Aboveground Storage Tanks").

3. The installation instructions of other system component manufacturers.

4. The construction documents and associated drawings.

5. "Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling," PEI/RP 200, Petroleum Equipment Institute.

D. **Advise the Owner of any shipping** or handling damage encountered.

E. **Make no modifications** to any tank without the prior written approval of the manufacturer and Engineer. This includes any welding on tank shells, adding penetrations in the tank structure, or repairing damage which might affect the integrity of the inner or outer tank.

3.3 CORROSION PROTECTION

A. **Protect any portion of the fueling system** in contact with the soil from corrosion in accordance with sound engineering practice and in accordance with NFPA 30A (2-4.8).

B. **Protect exposed piping and equipment** from corrosion by painting or wrapping it with a coating which is compatible with the product stored and the conditions of the exposure.

3.4 EQUIPMENT INSTALLATION

A. **Install tank, dispensers**, piping, and equipment in accordance with the manufacturer's installation instructions, industry standard recommended practices, and federal, state, and local regulations.

B. Calibration and start-up of equipment shall be performed by factory-trained qualified personnel.

3.5 TESTING

A. **Test all installed systems** for liquidtightness and proper operation, including:

1. Preinstallation inspection of all materials.

2. Product, containment, and vent piping during construction.

B. **Test each component of the system** for calibration, tightness and proper operation in accordance with the instructions of the component manufacturer.

C. **Document testing** and have it witnessed by the Owner.

1. Record the date and time of the test, the name of the tester and his affiliation with the project, and the names of each individual witnessing the test.

2. Record the test method, duration, and results.

3. Provide a record of the testing to the Owner at the time of system start-up.

D. Testing shall be witnessed by the Owner.

1. The Owner shall witness tank delivery and setting in place, anchoring, piping backfilling, piping tests, final precision testing, and system start-up.

2. The Owner shall indicate approval of all testing witnessed in writing.

E. **Perform tests in conformance** with the manufacturers' instructions, state laws, and the quoted industry standards, particularly PEI/RP200 and PER/RP100.

1. If a conflict exists between test protocols, perform the most stringent test.

2. Resolve any conflict which affects manufacturers' warranties before beginning construction.

3. Document all tests in writing, signed by the individuals who performed and witnessed the test.

F. **Demonstrate the operation** of all systems to the Owner at the time of the final start-up test.

1. Provide 1 day of instruction on the proper operation and maintenance of all components.

2. Demonstrations shall include, but are not limited to, pump operation, monitoring and gauging systems, fuel filter replacement, and leak detection.

3.6 TESTING PRIMARY AND SECONDARY TANKS

A. **Conduct air pressure testing** of the inner tank and secondary containment tank on-site, in the presence of the Owner, before placing the tank in service.

B. **Refer to manufacturer’s manual** for complete procedural details.

C. **Other integrity tests may be required** by the local authority having jurisdiction.

3.7 TEST DOCUMENTATION AND REPORTING

A. **Document all testing** and provide copies to the Owner and authorities having jurisdiction. Test records shall include:

1. Date and time of test.

2. Name of tester.

3. Names of any inspectors present.

4. Test procedure followed.

5. Test results.

B. **Provide documentation for all testing** with contract close-out documentation to the Owner.

C. **Ensure that future testing** is not impaired. The Contractor may be requested to demonstrate the tests as a part of the final approval process.

1. Inspection of tank interstices.

END OF SECTION

SECTION 40 05 13

PROCESS PIPING, GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1; Section 40 05 14, "Process Piping, Accessories"; and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the process piping in accordance with the drawings and as specified herein. This section, in conjunction with the corresponding process piping material sections, is intended to cover the supply and installation of all exposed (non-buried) process piping. This work shall also include all pipe supports and restraints, fittings, joints, testing, cleaning, and work on existing exposed process piping. See Division 33 for buried piping.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. All materials, testing, and workmanship shall be in conformance with the following standards and as referenced herein.

1. ANSI – American National Standards Institute.
2. ASME – American Society of Mechanical Engineers.
3. ASTM – American Society for Testing and Materials.
4. AWWA – American Water Works Association.
5. NSF – National Sanitary Foundation.

1.4 SUBMITTALS

A. **General**. Submit the specified submittal packages in accordance with Section 01 33 00, “Submittals” and the pipe material’s specific specification section included later in this contract document.

1.5 JOB CONDITIONS

A. **General**. Verify job conditions which may impact piping layouts and locations prior to ordering.

B. **Coordination**

1. Coordinate schedule of the work and the location of equipment and conduit to prevent interferences and delays.
2. Coordinate type and materials (gaskets, glands, and bolts) of joints connecting to valves and equipment with the suppliers of each item.

C. **Field Dimensions**. All piping shall be installed to field dimensions unless specifically stated on drawings.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. The delivery, storage, and handling of the process piping and accessories shall be in accordance with Section 01 60 00, "Materials and Equipment," and the manufacturer's instructions.

B. **Handling**. Handle all pipe, fittings, and accessories carefully using proper handling devices. Do not insert lifting devices into barrels of pipe.

C. **Storage**. Store pipe and fittings on wood blocking or platforms to avoid contact with ground. Keep pipe free from dirt and foreign matter. Plastic and fiberglass-reinforced plastic (FRP) piping shall be shaded but not covered directly to allow air circulation and reduce heat build-up due to direct sunlight.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **GENERAL**

A. **Pipe and Fittings**. All process piping, fittings, and joints shall conform to the drawings and requirements specified in the corresponding section for each type of pipe installed.

B. **Manufacturer**. All new process piping of one material shall be by a single manufacturer. All process fittings of one material shall be by a single manufacturer. All pipe and fittings manufactured outside the United States shall be certified to ISO 9001:2000 standards for quality assurance.

C. **Identification**

1. All pipe and fittings 4 inches in diameter and larger shall have the pipe size, material, and class or schedule painted or cast on the exterior pipe surface.
2. All piping less than 4 inches in diameter shall have the pipe size, material, and class or schedule factory marked on the exterior pipe surface.

2.2 **JOINTS**

A. **Flanged**

1. Standard. Conform to ANSI/AWWA C115/A21.15 or ANSI/ASME B16.1, Class 125, unless otherwise noted on the drawings.
2. Gaskets. All joints for 12 inches and smaller shall include 1/8-inch-thick full-face SBR red rubber gaskets unless noted otherwise. All joints for pipe 14 inches and larger shall include 1/8-inch-thick full-face synthetic

rubber gaskets with one or more annular rings. Gaskets shall conform to ANSI/AWWA C111/A21.11 and be rated to for a minimum of 170° F unless noted otherwise. All gasket types shall be suitable for the process material being conveyed.

a. Air and gas piping shall have high temperature type gaskets, rated to 300° F. Material shall be fluoroelastomer (FKM).

3. Bolts.

a. Non-submerged Service. Bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions conforming to ANSI B18.2.1 and ANSI/ASME B18.2.2. For bolts of 1-3/4-inch diameter and larger, bolt studs with a nut on each end are recommended. Material for nuts and bolts shall conform to ASTM A 307, Grade B.

b. Submerged Service. Bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions, all as specified in ANSI B18.2.2, "Square and Hex Nuts Inch Series." For bolts 1-2/4 inches in diameter and larger, bolt studs with a nut on each end are recommended. Material for bolts and nuts shall be Type 316 stainless steel. Utilize anti-seize compound on all nuts.

B. **Threaded**

1. Standard. Pipe threads shall conform to American Standard Taper Pipe thread ANSI B2.1.
2. Preparation. Threaded joints shall include a Teflon tape for sealant purposes.

C. **Grooved and Shouldered**

1. Standard. Conform to AWWA C606 unless otherwise noted on the drawings.
2. Couplings shall be ductile iron.
3. Gaskets. Gaskets shall conform to the same material requirements as the flanged joints.
4. Bolts. Bolts and nuts shall conform to the same material requirements as the flanged joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspection

1. All pipe shall be inspected for damage resulting from shipping and handling. Reject and replace all damaged pipe and fittings with a new piece at the Contractor's expense.
2. If any defective pipe or fitting is discovered after installation, remove and replace defective piece with a sound piece at the Contractor's expense.
3. All pipe and fittings shall be kept clean until they are accepted in the completed work.

3.2 INSTALLATION

A. **General**. Installation of all process piping shall be in accordance with manufacturer's instructions, approved shop drawings, drawings, and as specified herein.

1. Use of flange adapters and flanges, or flexible couplings, shall be acceptable only where shown on the approved dimensional layouts or drawings.
2. Conflicts between the specifications or drawings and the manufacturer's instructions shall be brought to the Engineer/Architect's attention and a solution documented by Field Order.

B. **Cutting**

1. Pipe cutting shall be neat, smooth, at right angles to the axis of the pipe, and without damage to the pipe, coating, or lining.
2. Flame cutting will not be permitted.
3. Ream all pipes and tubing to full inside diameter after cutting. Remove sharp edges on cut ends. Remove all cuttings from inside the pipe before installation.

C. **Alignment**

1. Install straight runs true to line and elevation and vertical pipe plumb in all directions.
2. Install parallel or perpendicular to building walls unless shown otherwise on the drawings.
3. Piping without specific locations or elevations indicated shall be located to avoid obstructions and shall not obstruct corridors, walkways, equipment areas, or work areas. A minimum headroom clearance of 7 feet 6 inches shall be provided under all piping unless otherwise noted.

D. **Temporary Caps**. Provide temporary caps or plugs at all pipe openings at the end of each day's work and where otherwise requested by the Engineer/Architect.

E. **Pipe Supports, Hangers, and Blocking**. Furnish and install, whether shown on the drawings or not, all required supports, hangers, and blocking.

1. Design, and provide a complete system of pipe supports with inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, sliding Teflon plate, and accessories as indicated or specified. The term pip support included hangers, guides, restraints, anchors, and saddles. Provide all support systems and the design of all support systems for all piping as specified herein.
2. The Contractor shall provide pipe support locations, configurations, and details through accepted shop drawing submittals stamped by a Registered Professional Engineer.
3. The Contractor shall be responsible for the proper design, fabrication, location, shop drawings, and installation of all pipe supports in accordance with the specified requirements.
4. Spacing of supports and hangers shall be as shown on the drawings, and in no instance exceed the manufacturer's recommendations for the type and class of pipe and temperature of liquid being carried.
5. Pipe hangers shall be provided at all bends and tees, and on either side of all valves.
6. Pipe supports, hangers, and thrust blocks shall be of the size, shape, and quantities as shown on the drawings or as required.
7. Thrust blocking shall be provided at all bends and tees, where changes in pipe diameter occur at reducers or in fittings, at all dead ends, and at pipes which are tapped or plugged.
8. All proposed hangers, supports, and blocking must be approved before placement.

F. **Pipe Fittings**

1. Unions. Unions shall be provided where shown on the drawings, and at the following locations:

    a. Downstream of each screwed end valve.
    b. Screwed or flanged union at each piece of equipment.
    c. Dielectric unions where dissimilar metals are connected except at bronze or brass valves installed in ferrous piping.
    d. Where necessary to install or dismantle piping.

2. Reducers. Eccentric reducers shall be installed where reducers are shown and where air or water pockets would occur in mains because of reduction in pipe size.

3. Transitions. Provide all necessary adapters, specials, and connector pieces when connecting different type and sizes of pipe, connecting pipe by different manufacturers, or connecting to equipment, valves, or meters.

G. **Joints**

1. Flanged.

a. Clean. Flange faces shall be clean. Hexagonal bolts and nuts shall be clean and lubricated.
b. Alignment. Joints shall be fitted so that contact faces bear uniformly on the gasket and are made up with uniform bolt stress.
c. Assembly. Assemble joints without forcing.

3.3 SCHEDULES

A. PIPE MATERIALS SCHEDULE

1. The piping shown on the drawings shall conform to the specific materials specifications provided in Division 40. The plans provide general information on pipe sizes, fittings, and materials. The schedule provided below is the provided as a general guide to be used to describe the pipe materials to be used unless otherwise noted on the drawings or specifications.

SCHEDULE NOT USED.

3.4 FIELD QUALITY CONTROL

A. **Testing**. All process piping shall be tested for leaks in accordance with Section 01 89 19, "Leakage Test and Disinfection." Visible leakage will not be accepted in exposed piping. If the test fails, repair or replace the piping and retest.

B. **Cleaning**. All process piping shall be thoroughly cleaned and flushed prior to placing in service in a manner acceptable to the Engineer/Architect. Piping shall be inspected and all debris, dirt, and foreign matter removed. Disinfection shall be done in accordance with Section 01 89 19, "Leakage Test and Disinfection."

END OF SECTION

SECTION 40 05 13.13

PROCESS PIPING, CARBON AND GALVANIZED STEEL

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the carbon and galvanized steel process piping in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 40 05 13, Process Piping, General.

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. No piping or fittings shall be delivered or installed before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

   a. Illustrated product data. Submit the product data of the pipe, fittings, manufacturer's name, pipe material, size, class, and gaskets specified in the drawings.
   b. Submit the manufacturer's recommended maximum unsupported length of the size piping specified.
   c. Affidavit of compliance and certification of design and performance.
   d. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
   e. Description of proposed test methods, procedures, and apparatus.
   f. Coatings and linings.

B. **Submittal Package No. 2 – Layout Drawings**

1. No piping or fittings shall be delivered or installed before this submittal package has been reviewed and approved. Layout drawings shall include:

   a. Submit detailed plan and profile drawings showing details of piping, fittings, end connections, valve locations, and locations of all flanged joints.
   b. Piping supports, hangers, and thrust block type and locations.

1.5 **JOB CONDITIONS**. In accordance with Section 40 05 13, Process Piping, General.

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 40 05 13, Process Piping, General.

1.7 **SPECIAL WARRANTY**

(Not Used)

PART 2- PRODUCTS

2.1 **CARBON STEEL PIPE**

A. **Pipe**. Steel pipe shall conform to American Society for Testing and Materials (ASTM) A 53, Schedule 40. Pipe ends shall be grooved in accordance with American National Standards Institute/American Water Works Association (ANSI/AWWA) C-606.

B. **Fittings**. Fittings shall be ductile iron conforming to ASTM A 356, Grade 65-45-12, forged steel conforming to ASTM A 234, or fabricated steel conforming to ASTM A 53 suitable for a minimum working pressure of 150 pounds per square inch (psi) and conforming to ANSI B16.3.

C. **Joints**. All joints shall be welded, threaded, or grooved in accordance with Section 40 05 13, Process Piping, General. Welded joints shall conform to AWWA C206.

D. **Finishes**. Coat exposed pipe not having insulation in accordance with Section 09 90 00, Painting. Line all steel pipe and fitting with a coal tar in accordance with AWWA C203.

2.2 **GALVANIZED STEEL PIPE**. Pipe and fittings noted for galvanized steel construction shall conform to carbon steel requirements above, with the following modification.

A. **Finishes**. All galvanized pipe and fittings shall be hot-dipped galvanized after fabrication.

PART 3 - EXECUTION. In accordance with Section 40 05 13, Process Piping, General.

END OF SECTION

SECTION 40 05 13.14

PROCESS PIPING, STAINLESS STEEL

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide all labor, materials, tools, and equipment necessary to furnish and install the stainless steel pipe in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 40 05 13, Process Piping, General.

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

   a. Illustrated Product Data. Submit the product data of the pipe, fittings, manufacturer's name, pipe material, size, class, and gaskets specified on the drawings.
   b. The manufacturer's recommended maximum unsupported length of the size piping specified.
   c. Affidavit of compliance and certification of design and performance.
   d. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
   e. Description of proposed test methods, procedures, and apparatus.
   f. Coatings and linings.

B. **Submittal Package No. 2 – Layout Drawings**

1. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Layout drawings shall include:

   a. Detailed plan and profile drawings showing details of piping, fittings, end connections, valve locations, and locations of all flanged joints.
   b. Piping supports, hangers, and thrust block type and locations.

1.5 **JOB CONDITIONS.** In accordance with Section 40 05 13, Process Piping, General.

1.6 **DELIVERY, STORAGE, AND HANDLING.** In accordance with Section 40 05 13, Process Piping, General.

1.7 **SPECIAL WARRANTY**

(Not Used)

PART 2 - PRODUCTS

2.1 FABRICATED STAINLESS STEEL PIPE

A. Design Criteria

Standards. Stainless steel pipe shall conform to American Society for Testing and Materials (ASTM) A 774 and A 778.

1. Wall Design Criteria.

   a. Rated from a 6-pound-per-square-inch (psi) vacuum to an 150 pound-per-square-inch (psi) pressure.

   b. Supply pipe with wall thickness required for pressure rating above or the following minimum wall thickness, whichever is greater.

Diameter	Wall Thickness
12 Inches and Less	0.109 Inch
14 Inches through 18 Inches	0.125 Inch
20 Inches	0.145 Inch
24 Inches	0.187 Inch

2. Diameter. Outside diameter shall conform to Iron Pipe Size (IPS) standards.

B. Pipe and Fitting Materials and Construction

1. Fabrication.

   a. Longitudinal Seams. Maximum of two per section.
   b. Girth Seams. Not less than 6 feet apart except at fittings and special.
   c. Pipe Ends. Perpendicular to longitudinal axis. If grooved joints are being used, groove the pipe conforming to American Water Works Association (AWWA) C606.
   d. Roundness. Plus or minus 1/16 inch.
   e. Straightness. Plus or minus 1/8 inch in 10 feet.
   f. Edges. All joint-edges shall be true so as not to leave a shoulder on the inside of the pipe.
   g. Fittings. Smooth radius.

2. Welding.

   a. Shop-weld all seams.

b. Longitudinal Seams. Tungsten inert gas or metallic inert gas method.
c. Circumferential Seams. Tungsten inert gas method.
d. Welding Rods or Wire. Same composition or superior to material used to fabricate pipe.
e. Grind all interior welds smooth to provide an internal head of 1/16 inch or less.

3. Materials.

a. ASTM A 240, Grade TP 316L.
b. No. 2 finish.

4. Grooved Fittings. Fittings shall be smooth-turn, full-flow, stainless steel fittings to ASTM A312 with grooved design to accept grooved end couplings.

C. **Joints**

1. General. All joints shall be flanged or grooved in accordance with Section 40 05 13, Process Piping, General, unless shown otherwise.

2. Flanged Joints. Two part flange.

a. Slip-on rolled angle face rings of 1/8 inch stainless for pipe less than 16 inches in diameter and 3/16 inch thick for pipe 16 inches and larger.

b. Backing Flange. Hot dipped galvanized ductile iron drilled to American National Standards Institute (ANSI) B16.1, Class 125 standards. Minimum flange thickness shall be:

Diameter	Flange Thickness
6 to 10 Inches	5/8 Inch
12 to 16 Inches	3/4 Inch
18 to 20 Inches	7/8 Inch
24 to 30 Inches	1 Inch

D. **Finishes**

1. After all fabrication operations are complete, pickle and passivate all pipe and fittings.
2. No pipe and fitting interior and exterior finishes in the field.

PART 3 - EXECUTION. In accordance with Section 40 05 13, Process Piping, General.

END OF SECTION

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SECTION 40 05 13.33

PROCESS PIPING, COPPER

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the copper process piping.

1.3 **QUALITY ASSURANCE**

A. **General**. In accordance with Section 40 05 13, Process Piping, General.

1.4 **SUBMITTALS**

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Submit shop drawings and product data for review and approval. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

   a. Illustrated Product Data. Submit the product data of the pipe, fittings, manufacturer's name, pipe material, size, class, and gaskets specified on the drawings.
   b. The manufacturer's recommended maximum unsupported length of the size piping specified.
   c. Affidavit of compliance and certification of design and performance.
   d. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
   e. Description of proposed test methods, procedures, and apparatus.
   f. Coatings and linings.

C. **Submittal Package No. 2 – Layout Drawings**

1. Submit layout drawings according to this specification for review and approval. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Layout drawings shall include:

a. Detailed plan and profile drawings showing details of piping, fittings, end connections, valve locations, and locations of all flanged joints.
b. Piping supports, hangers, and thrust block type and locations.

1.5 **JOB CONDITIONS**

A. **General**. In accordance with Section 40 05 13, Process Piping, General.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. In accordance with Section 40 05 13, Process Piping, General.

1.7 **SPECIAL WARRANTY**

(Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Copper Pipe**

1. General. All copper process piping shall comply with the following, unless otherwise noted on the drawings or herein.

a. Standard. ASTM B 88, Type L, hard drawn.
b. Joints. Soldered except at valves which may be flared or compression type.

B. **Joints**

1. Soldered.

a. Standard. Comply with ASTM B 32.
b. Material. 95-5 tin antimony solder.

2. Press Tube Joint.

a. Viega ProPress, or Engineer approved equal.

C. **Fittings**

1. Wrought Copper Solder Joint Fittings. ANSI/ASME B16.22, streamlined pattern.

2. Wrought Copper and Bronze Groove End Fittings. ASTM B 75 tube and ASTM B 584 bronze castings.

3. Press Tube Fittings. Viega ProPress, or Engineer approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. In accordance with Section 40 05 13, Process Piping, General.

B. **Hangers**

1. Furnish and install isolators where dissimilar metals occur between the pipe and hangers.

END OF SECTION

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SECTION 40 05 13.73

PROCESS PIPING, PVC AND CPVC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping, General"; and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) process piping.

1.3 QUALITY ASSURANCE

A. **General**. In accordance with Section 40 05 13, "Process Piping, General."

1.4 SUBMITTALS

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Submit shop drawings and product data review and approval. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

    a. Illustrated product data. Submit the product data of the pipe, fittings, manufacturer's name, pipe material, size, class, and gaskets specified on the drawings.
    b. Submit the manufacturer's recommended maximum unsupported length of the size piping specified.
    c. Affidavit of compliance and certification of design and performance.
    d. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
    e. Description of proposed test methods, procedures, and apparatus.
    f. Coatings and linings.

C. **Submittal Package No. 2 – Layout Drawings**

1. Submit layout drawings according to this specification for review and approval. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Layout drawings shall include:
   a. Detailed plan and profile drawings showing details of piping, fittings, end connections, valve locations, and locations of all flanged joints.
   b. Piping supports, hangars, and thrust block type and locations.

1.5 **JOB CONDITIONS**

A. **General**. In accordance with Section 40 05 13, "Process Piping, General."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. In accordance with Section 40 05 13, "Process Piping, General."

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **PVC PIPE AND FITTINGS**

A. **Design Criteria**

1. Pipe and Fitting Materials.
   a. Type. Materials shall be Type 1, Grade 1, rigid.

2. Standards.
   a. PVC pipe shall conform to American Society for Testing and Materials (ASTM) D 1785, PVC 1120.
   b. All PVC pipe fittings shall conform to ASTM D 2467, PVC 1120.

3. Pressure Rating. PVC process piping and fittings shall be suitable for a minimum working pressure of 150 pounds per square inch (psi), unless noted otherwise on the plans.

4. Minimum Wall Thickness. PVC process piping and fittings shall be Schedule 80 unless noted otherwise on the plans.

B. **Pipe and Fitting Materials**

1. Type. Materials shall be Type 1, Grade 1, rigid.

C. **Joints**

1. General. All PVC pipe shall be joined with solvent-cemented socket-type joints except where flanged or threaded joints are required at expansion joints, valves, flowmeters, or equipment connections, or when shown otherwise on the plans or directed by the Engineer.

2. Solvent Cement.
   a. Solvent primer shall conform to ASTM F 656 and be National Sanitary Foundation (NSF-) approved for potable water.
   b. Cement shall be a heavy-bodied, medium-setting, high-strength, chemical-resistant solvent cement, conforming to ASTM F 493 and shall be NSF-approved for potable water.
   c. Cement shall be suitable for both PVC and CPVC applications.
   d. Primer and cement shall be from the same manufacturer.

3. Flanged Joints.
   a. In accordance with Section 40 05 13, "Process Piping, General," paragraph 2.2 A.
   b. Joining. PVC flanges shall be joined to the pipe by solvent cementing.
   c. Threaded. In accordance with Section 40 05 13, "Process Piping, General," paragraph 2.2 B.

D. **Finishes**

1. Pipe and Fitting Exterior. Perform all finishes in the field in accordance with Section 09 90 00, "Painting."
2. Pipe and Fitting Interior. None.

2.2 **CPVC**

A. **Material**. Pipe and fittings noted for CPVC construction shall conform to PVC requirements noted above, with the following modification. CPVC shall conform to ASTM D 1784, Cell Class 23447-B, Schedule 80, unless noted otherwise. CPVC shall be manufactured in compliance with ASTM F 441.

PART 3 - EXECUTION

3.1 **GENERAL**. In accordance with Section 40 05 13, "Process Piping, General."

3.2 **INSTALLATION**

A. **Joints**. Installation shall be in accordance with manufacturer's instructions, as shown on the plans, with Section 40 05 13, and as specified herein.

1. Solvent Cemented. Install the PVC and CPVC pipe and solvent-cemented joints shall be in strict accordance with manufacturer's instructions. Give special attention manufacturer's recommended shelf life for primer and solvent cement.

END OF SECTION

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SECTION 40 05 16

PROCESS PIPING, DUCTILE IRON

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the ductile iron process piping in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 40 05 13, "Process Piping."

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

   a. Illustrated Product Data. Submit the product data of the pipe, fittings, manufacturer's name, pipe material, size, class, and gaskets specified on the drawings.
   b. The manufacturer's recommended maximum unsupported length of the size piping specified.
   c. Affidavit of compliance and certification of design and performance.
   d. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
   e. Description of proposed test methods, procedures, and apparatus.
   f. Coatings and linings.

B. **Submittal Package No. 2 – Layout Drawings**

1. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Layout drawings shall include:

   a. Detailed plan and profile drawings showing details of piping, fittings, end connections, valve locations, and locations of all flanged joints.
   b. Piping supports, hangers, and thrust block type and locations.

1.5 **JOB CONDITIONS**. In accordance with Section 40 05 13, "Process Piping."

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 40 05 13, "Process Piping."

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. **Pipe**

1. Standard. Conform to American National Standards Institute/American Water Works Association (ANSI/AWWA) C151/A21.51 and the chemical constituents shall meet the physical property recommendations of American Society for Testing and Materials (ASTM) A 536 to ensure suitability for drilling and cutting.
2. Thickness. Pipe barrel thickness shall be a minimum of Class 53 unless otherwise shown.

B. **Fittings**

1. Standard. Fittings shall be ductile iron conforming to ANSI/AWWA C110/A21.10.

2. Pressure Rating for Fittings.

    a. Flanged ductile iron fittings shall be suitable for 250 pound- per-square-inch (psi) working pressure.
    b. Nonflanged ductile iron fittings less than 12 inches in diameter shall be suitable for 350 psi working pressure.
    c. All ductile iron fittings 14 inches in diameter and larger shall be suitable for 250 psi working pressure.

C. **Joints**. Flange or groove all joints in accordance with Section 40 05 13, "Process Piping," unless otherwise shown.

D. **Coatings and Linings**

1. Coat interior wall of pipe and fittings as listed below and conforming to the following ANSI/AWWA Standards: ANSI/AWWA C104/A21.4 and ANSI/AWWA C151/AA21.5. Specific lining requirements listed on the drawings take precedence over the following listing.
2. Interior lining coatings to be used are as follows
    a. Coating 1: Cement Lined with or without NSF 61 Approved Seal Coat
    b. Coating 2: Cement Lined with NSF 61 Approved Seal Coat or Asphalt coating
        1) Coating 3: Unlined
    c. Coating 4: Ceramic Epoxy: Protecto 401 or approved equivalent coating by Sherwin Williams or Tnemec.
    d. Coating 5: Glass Lined
    e. Coating 6: Fusion Bonded Epoxy or polyolefin
3. Interior lining coatings should be used per the following schedule
    a. Potable Water: Coating 1
    b. Water Treatment Plant process piping prior to potable status: Coating 1
    c. Non-Potable Water: Coating 1

d. Raw sewage: Coating 2
e. WWTP process piping other than sludge: Coating 2
f. WTP sludge lines: Coating 2 or 4
g. WWTP Sludge (except as otherwise listed): Coating 2 or 4
h. WWTP thickened sludge: Coating 4
i. WWTP Anaerobically digested sludge: Coating 5
j. Fittings: Coating 6 or Coating 1 or 2 where adjacent pipe has same coating.
k. Air lines: Coating 3
l. Any line at a temperature at or above 150 F: Coating 3
m. Laboratory piping or lines conveying non-dilute acids: Coating 5

4. Exterior Coating: Coat exterior wall of exposed pipe and fittings with shop primer specified in Section 09 90 00 for ferrous metals.
5. Buried Pipe protection: All buried Ductile Iron Pipe shall be wrapped with a polyethlene wrap in accord with ANSI/AWWA C105/A21.5. This requirement includes fittings that have a fusion bonded epoxy or polyolelin exterior coating. Any pipe which will operate at temperatures of 180 F or greater, including compressed air lines, shall use a high density cross laminated polyethylene (HDCLPE) wrap.

PART 3 – EXECUTION. In accordance with Section 40 05 13, "Process Piping."

END OF SECTION

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SECTION 40 05 18

PROCESS PIPING, ACCESSORIES

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the process piping accessories in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**

A. **Standards**. All materials, testing, and work performed shall be in conformance with the following standards as referenced herein:

1. ANSI – American National Standards Institute.
2. ASTM – American Society for Testing and Materials.
3. AWWA – American Water Works Association.
4. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry.

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. No piping accessories shall be delivered or installed before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

a. Illustrated product data.
b. Affidavit of compliance and certification of design and performance.
c. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
d. Description of proposed test methods, procedures, and apparatus.
e. Coatings and linings.

1.5 **JOB CONDITIONS**. Coordinate work with that of other sections to provide proper combination of pipe size, core or sleeve size, and link size.

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 40 05 13, "Process Piping."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 MECHANICAL PIPE SEALS

A. **General.** Mechanical pipe seals shall be expandable link type rubber seals to fill the annular space between pipe or conduit and the cored hole or sleeve through which it passes. The seals shall provide airtightness and watertightness as well as electrical insulation between the pipe or conduit and wall or floor opening.

B. **Application**

1. Seal pipes or conduits passing through sleeves or cored openings in exterior walls or walls subject to hydrostatic pressure at each face of the wall.
2. Seal all pipes or conduits passing through floor, roof or interior wall sleeves or cored openings at one face only, unless specifically shown otherwise.
3. Included in this section are pipes and conduits including round electrical ducts. These are all referred to as pipes in the balance of this section.

C. **Products**

1. General Use. Seals shall incorporate an ethylene-propylene dienemonomer (EPDM) rubber sealing element with 316 stainless steel bolts and nuts and glass reinforced nylon plastic plates.
2. Size seals in accordance with manufacturer's recommendations.
3. Cored opening size shall be as recommended by the mechanical seal manufacturer.
4. Manufacturer. Seals shall be Link-Seal, Service Designation S (corrosive service), by Thunderline Corporation or approved equal.

2.2 WALL AND FLOOR PIPES AND PIPE SLEEVES

A. **Wall and Floor Pipes**

1. Type. Wall and floor pipes shall be of the same material and wall thickness specified for the connected piping.
2. Collar. Include an integral collar at the midpoint of the wall or floor pipe for anchorage and watertightness. Collar shall be integral with the body or continuously welded on both sides to the body.
3. End Connections. End connections shall be as shown. Drill and tap mechanical joint bells and flanged ends for studs.
4. Provide studs of the same material as connected piping. Submerged or buried studs shall be Type 304 stainless steel.

B. **Pipe Sleeves**

1. Type. Pipe sleeves shall be ductile iron with a minimum working pressure rating of 350 pounds per square inch (psi).
2. End Connections. Pipe sleeve end connections shall be as shown.
3. Size. Pipe sleeve dimensions shall be as required for pipes to pass through the sleeve. Length shall be as required or as shown.

5. HDPE sleeves may be used in lieu of ductile iron in conjunction with matching link seals. Century-Line Sleeves, or equal.

2.3 **PIPE SUPPORT**

A. **General**

1. Furnish and install all necessary restraints, blocks, bracing, supports, or hangers, including all necessary miscellaneous steel, inserts, anchors, nuts, bolts, and concrete to support and anchor the piping as shown and required to prevent displacement, vibration, sagging, warping, or failure of the piping expansion and contraction.
2. Locate all supports in accordance with the piping manufacturer's recommendations.

B. **Standard**. Pipe hangers shall be in accordance with MSS Standard Practice SP-58 unless noted otherwise.

C. **Types**. The following types of pipe supports are acceptable.

1. Hanger Type.

a. Adjustable Clevis. Clevis shall be carbon steel unless noted otherwise. Clevis shall be in compliance with MSS SP-69, Type 1.

b. Trapeze. Universal trapeze assembly shall be carbon steel unless noted otherwise. Trapeze assembly shall be Anvil Figure 46, or equal.

c. Structural Attachments.

1) Welded Steel Bracket. MSS SP-69, Types 31, 32, and 33.
2) Malleable Concrete Insert. MSS SP-69, Type 18.

2. Support Type.

a. Pipe Saddle Support. MSS SP-69, Types 35, 36, and 38.
b. Pipe Stanchion Saddle. MSS SP-69, Type 37.

3. Submit any additional pipe support required not listed above for review.

D. **Coatings**. Conform to Section 09 90 00, "Painting."

1. Hot-dip-galvanize steel items at the factory unless otherwise noted.
2. Copper-plate steel or malleable iron materials used for support of copper piping.

2.4 **CONCRETE PIPE SUPPORT**. Install concrete pipe support and thrust blocking as shown and where directed.

2.5 **CORPORATION STOPS**. Install corporation stops where shown. Corporation stops shall be bronze body and ground key plug with AWWA C800 taper threaded inlet and outlet to match the connecting piping material.

2.6 **EXPANSION COUPLINGS**

A. **General**. Expansion couplings shall be arch type, constructed of a single piece of synthetic or natural rubber with wire reinforcing and integral full faced flanges. The wall thickness, dimensions, exterior coating, control rod requirements, and number of arches shall be in accordance with manufacturer's recommendations.

B. **Service**. Pressure rating shall be the same as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

C. **Joints**. Joints shall be flanged in accordance with ANSI B12.1. Flanges shall be constructed of resilient rubber, full face, with galvanized metal or baked enamel ductile iron retaining rings providing a metal backup ring behind the rubber flange.

D. **Manufacturer**. Subject to compliance with the specifications, provide expansion couplings from one of the following approved manufacturers.

1. General Rubber Corporation.
2. Mercer Rubber Company.
3. MetraFlex.
4. Flexicraft.
5. Proco Products, Inc.

2.7 **SLEEVE COUPLINGS**

A. **General**. Provide sleeve couplings where shown to tightly seal piping without leakage and allow for deflection and vibration within the pipe line and meet the requirements of AWWA C219.

B. **Construction**

1. Followers shall be cast iron or ductile iron.
2. Sleeves shall be carbon steel or ductile iron.
3. Bolts. Bolts shall be of a corrosion-resistant material.
4. Gaskets. Provide resilient gaskets to cushion vibration and safely accommodate for pipe deflection or longitudinal pipe movement without leakage. Gaskets shall be suitable for the service of the pipe.
5. Coating. Coatings shall be according to manufacturer's instructions and be suitable for the service of the pipe. Shop-prime and field-coat the couplings in accordance with Section 09 90 00, "Painting."

C. **Service**. Couplings shall be rated for the same pressure as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

D. **Manufacturer**. Subject to compliance with the specifications, provide sleeve couplings from one of the following approved manufacturers.

1. Dresser. Style 38/138.
2. Smith Blair. Style 411.
3. Romac. Style 400.
4. JCM. Style 201.
5. Ford Meter Box. Style FC3/FC4.

2.8 FLANGED COUPLING ADAPTERS

A. **General**. Flanged coupling adapters shall include a flanged end and a sleeve-type flexible coupling and meet the requirements of AWWA C219.

B. **Adapter Restraints**. Harness adapters as required to restrain pressure piping.

1. For 12 inches in diameter or less, harnessing shall be with 1/2-inch stainless steel anchor studs.
2. For larger than 12 inches in diameter, harnessing shall be with a minimum of four corrosion resistant alloy steel bolts tied to adjacent flange or lugs on the pipe.
3. Number of bolts or studs shall be according to manufacturer's recommendation.

C. **Construction**

1. The adaptors shall be cast iron or ductile iron.
2. Bolts shall be of a corrosion resistant material.
3. Gaskets. Provide resilient gaskets to cushion vibration and safely accommodate for pipe deflection or longitudinal pipe movement without leakage. Gaskets shall be suitable for the service of the pipe.
4. Coating. Coatings shall be according to manufacturer's instructions and be suitable for the service of the pipe. Shop-prime and field-paint the joints in accordance with Section 09 90 00, "Painting."

D. **Service**. Flanged coupling adapters shall be rated for the same pressure as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

E. **Manufacturer**. Subject to compliance with the specifications, provide flanged coupling adapters from one of the following approved manufacturers.

1. Smith Blair. Style 912.
2. Dresser. Style 227.
3. JCM. 301.
4. ROMAC. 501.
5. Ford Meter Box. Style FFCA.

2.9 DISMANTLING JOINTS

A. **General**. Provide dismantling joints where shown to tightly seal piping without leakage and allow for deflection and vibration within the pipe line. This fitting shall also be fully restrained.

B. **Service**. Dismantling joints shall be rated for the same pressure as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

C. **Construction**

1. The joints shall be cast iron or ductile iron.
2. Bolts shall be of a corrosion resistant material.
3. Gaskets. Provide resilient gaskets to cushion vibration and safely accommodate for pipe deflection or longitudinal pipe movement without leakage. Gaskets shall be suitable for the service of the pipe.
4. Coating. Coatings shall be according to manufacturer's instructions and be suitable for the service of the pipe. Shop-prime and field-paint the joints in accordance with Section 09 90 00, "Painting."

D. **Manufacturer**. Subject to compliance with the specifications, provide dismantling joints from one of the following approved manufacturers.

1. Dresser. Style 131.
2. Smith Blair. Model 975.
3. JCM. Restrained Style 309.
4. ROMAC. Style DJ400.
5. Ford Meter Box. Style FDJ.

2.10 HOSE STATIONS AND HOSE REEL ASSEMBLIES

A. Rubber Hose:

1. Rubber shall be premium quality multipurpose nitrile hose that is recommended for abusive industrial applications in diameters and lengths as shown in the schedule. Hose shall be oil resistant, suited for potable water applications.
2. Rubber hose shall be reinforced with spiral synthetic yarn to provide excellent kink resistance. Reinforced for excellent kink and abrasion resistance, and suited for use in ambient air temperatures of -20°F to 190°F.
3. Provide specified lengths shown in Schedule.
4. Manufacturers: Hose Craft, Reelcraft, Flexcraft or equal.

B. Spray Jet Nozzle

1. Provide spray nozzle Model 1720 by Akron Brass or equal. 1.5 inch diameter combination solid bore and/or spray fog nozzle. TurboJet Combination with Dual Shutoff.
2. Nozzle shall be constructed of reinforced fiberglass or plastics, with brass wear components, 316 SS hardware and fasteners, and chrome plated or non-metallic wear surfaces.
3. Nozzle design will be adjustment from lightweight fog and straight stream nozzle with multiple fixed constant gallonage settings, allow adjustment from single bore to full jet, and provide ability to flow both at the same time. The nozzle shall have spinning teeth, multiple pattern

detents, a one-piece solid rubber-like handle with dual handle stops, dual drive trunnions and an extruded Pyrolite or reinforced plastic body. The nozzle shall also have a minimum 110° angle at wide fog, a full-time swivel inlet, come with a ten-year warranty, be capable of flushing without shutting down. Must meet all aspects of NFPA 1964 with test results available.

4. The Dual Shutoff TurboJet nozzle shall be able to operate efficiently at pressures as low as 50 psi, and up to 110 psi for maximum flow.

5. Configuration: Pistol Grip with 1.5" NPT swivel inlet connection.

6. Solid Bore Flow Capacity: 82 gpm at 75 psi, with 125 feet of reach with solid bore reach;

C. Quick-Disconnect Fitting:

1. Provide brass quick disconnect fitting at each 1.5-inch hose station

D. Hose Reels

1. Provide Hose Reels for 1.5" rubber hose storage at locations shown on drawings and specified in Schedule. Working pressure shall vary from 50 psi to 100 psi. Unit shall be provided with swivel connection at inlet, and Victaulic slot for piping connections.

2. Construction: 304 SS with non-sparking, spring rewind hose reels with a declutching arbor to prevent damage from reverse winding, and have a 4-way roller assembly. The hose reel shall be capable of storing 50 lineal feet of 1.5" diameter rubber nitrile hose with minimum 2.0-inch O.D. hoses Model 900 Series reels manufactured by Hosecraft (basis of design), Reelcraft, Graco, Aeroquip, Flexcraft, or equal.

3. Arrangement: Design shall be suited for wall mount with vertical take-up of hose. Provide adjustable stop for hose take-up. Provide properly sized 316 SS fasteners for mounting reel to concrete or masonry walls.

4. Mounting: Contractor to provide 304 stainless brackets to mount to aluminum handrail using stainless steel Unistrut framing to support hose reel per detail on plans. Supports system and fasteners shall be provided in accordance with specifications for Division 5, Section 05 00 00, Miscellaneous Metals.

PART 3 – EXECUTION. Install all piping accessories according to manufacturer's instructions, and as shown.

END OF SECTION

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SECTION 40 05 23

PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the valves and accessories in accordance with the drawings and as specified herein. Provide all valves required for complete functional systems.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies.** Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards.** Materials and workmanship shall be in accordance with the following standards as referenced herein:

1. AGA - American Gas Association.
2. ANSI - American National Standards Institute.
3. ASME - American Society of Mechanical Engineers.
4. ASTM - American Society for Testing and Materials.
5. AWWA - American Water Works Association.
6. IEC - International Electromechanical Commission.
7. NEMA - National Electrical Manufacturers Association.
8. NSF - National Sanitation Foundation.

1.4 SUBMITTALS

A. **Shop Drawings and Product Data**. Shop drawings and product data for each type of valve shall be submitted to the Engineer/Architect for review. Shop drawings shall be in accordance with Section 01 33 00 and shall include:

1. Manufacturer's name.
2. Body, seating, and trim materials.
3. Dimensions.
4. Connection details.
5. Required clearances.
6. Parts list with materials and part numbers for the valves and accessories.
7. Maximum operating pressure and temperature ratings.
8. Operator torque calculations.
9. Manufacturer's instructions.
10. Electrical data when applicable.

B. **Test Reports**

1. Submit hydrostatic test reports as specified in this section.

C. **Operation and Maintenance Manuals**. Operation and Maintenance (O&M) manuals shall be submitted to the Engineer/Architect in accordance with Section 01 33 00 of these specifications. The initial review copy of the O&M manual and the revised copies shall be submitted prior to delivery of the equipment.

1.5 **JOB CONDITIONS**

A. **Valve Service**

1. Submerged valves shall be designed for submerged service.
2. Buried valves shall be designed for buried service.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General.** The delivery, storage, and handling of the process piping valves and gates shall be in accordance with Section 01 60 00 and the manufacturer's instructions.

B. **Storage.** Store valves under cover and out of direct contact with the ground.

C. **Handling.** Handle valves to avoid damage. Valves which are cracked, dented, dropped, or otherwise damaged will not be accepted.

1.7 **SPECIAL WARRANTY (**Not used.)

PART 2 - PRODUCTS

2.1 **GENERAL REQUIREMENTS**

A. **Manufacturer**

1. Each type of valve shall be by only one manufacturer.

B. **Valve Ends**

1. All joint materials shall be provided in accordance with the requirements for suitability to handle pressure, temperature, and chemical resistance for intended use and application.

2. All valves shall be joined to pipe with the following methods and materials:

   a. Flanged joint materials are to be provided in accordance with Section 40 05 13, "Process Piping, General," paragraph 2.2 A.
   b. Threaded. In accordance with Section 40 05 13, "Process Piping, General," paragraph 2.2 B.

3. Valves on exposed piping shall be as shown on drawings, usually with a symbol. Connections shown include:

a. Flanged. (FL) Valves shall be rated for 150 psi working pressure unless noted otherwise in the Valve Schedule or on the drawings. Flanges to match ANSI B16.5, Class 150 unless noted otherwise.
b. Screwed. National (tapered) pipe thread (NPT).
c. Socket. Conform to specifications for adjacent piping.
d. True Union. Conform to specifications for adjacent piping. True union ends shall be used for all polyvinyl chloride (PVC) valves.

4. Buried. Mechanical joint (MJ), unless noted otherwise on the drawings.
a. MJ. AWWA C111, rubber gasket joints for ductile iron pressure pipe and fittings.
b. Screwed. NPT.
c. Socket. Conform to specifications for adjacent piping.

C. **Seals**

1. Buried and submerged valves shall have enclosed, nonlubricated, watertight stem seals.

D. **Operators**

1. Valves shall open counterclockwise unless noted otherwise on the Valve Schedule or on the drawings.
2. All valves shall have permanent open direction indicator.
3. Coordinate valve mounting position with respect to operating convenience, maintenance access, and safety. Install chainwheel operators on manually operated valves more than 60 inches (1500 mm) above floor. Extend chains to 36 inches (900 mm) above finished floor elevation. Where valves are above aisles, provide 1/2-inch stainless steel hook bolt to tie chains to sides to keep chain out of walking area.
4. Valves which are installed with improper orientation shall be removed and reinstalled at no additional cost to the Owner.
5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operators to open or close the valve against specified criteria or process operating conditions.
6. Gear actuators shall meet the requirements of Section 2.3 of this specification. Gear actuators and valve components shall be able to withstand a minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut.
7. Electric operators shall meet the requirements of Section 2.3 of this specification. Valve accessories for handwheels or chainwheels shall meet the requirements of Section 2.4 of this specification.
8. Manual operators shall include handwheel, chainwheel, crank, lever, or T-handle wrench shall meet the requirements as specified in Section 2.4 of this specification.

E. **Coatings**

1. Valve Operators and Accessories Inside Structures.

a. Shop priming shall be in conformance with Section 09 90 00, "Painting."

b. Factory finishing shall be in conformance with Section 09 90 00, "Painting."

2. Buried Valves, Operators, and Accessories.

a. All buried valve operators and accessories shall be coated with two-part epoxy in accordance with AWWA C-550.

3. Painted Surfaces. Unless noted otherwise, all interior and exterior ferrous surfaces of all valves, operators, and accessories shall be primed and finish painted in the factory in accordance with Section 09 90 00, "Painting."

4. All valve operator and accessory coatings in contact with potable water shall meet NSF Standard 61 and will have to be listed by NSF and/or the Ohio Environmental Protection Agency (EPA).

5. Stainless steel surfaces shall not be painted unless otherwise noted.

2.2 VALVE TYPES

A. Air Release Valve, Sewage

1. Body and cover shall be cast iron conforming to ASTM A 126.

2. Internal linkage, stem, and concave float shall be stainless steel.

3. Seats: Stainless steel or brass and Buna-N

4. 2-inch NPT inlet and 1/2-inch NPT outlet.

5. Orifice 3/16-inch diameter for 150 psi rated pressure, 3/32-inch diameter for 300 psi rated pressure.

6. Provide blowoff valve, inlet valve, and shutoff valve for backflushing.

7. Rated for 150 pounds per square inch (psi).

8. Valves shall have backwash accessories to clean the valve consisting of the following items:

a. Inlet shut-off bronze valve
b. Blow-off bronze valve
c. Clean water inlet bronze valve
d. Quick disconnect coupling to accommodate hose connection.

9. Manufacturers.

a. Apco Valve and Primer Corporation, Model 450.
b. GA Industries Figure 920
c. Val-Matic wastewater air release valve
d. Or approved equal.

B. **Air and Vacuum Valve Assembly**

1. Air and vacuum valves shall consist of a ductile iron body as per ASTM A536, Grade 65-45-12, stainless steel float, and tight closing seat with Buna-N seal.

2. All internal parts, such as float guide, bushings, and baffle retaining screws shall be either stainless steel or bronze.

3. Stainless steel float shall be center guided for positive seating and rated 1,000 psi nonshock service.

4. Valve shall have flanged inlet and threaded discharge.

5. The baffle shall shield the float from direct impact of air and water to prevent premature float closure.

6. The seat shall slip fit into the baffle and lock in place without any distortion, and shall be easily removable.

7. Air and vacuum valve assemblies shall have a rating of 125 psi or as noted in the Valve Schedule.

8. A surge check valve shall be provided at the inlet side of the air and vacuum valve. The surge check valve shall not interfere with the operation of the air and vacuum valve. The body shall be constructed of ductile iron as per ASTM A 536, Grade 65-45-12.

9. Air and vacuum valve shall have 1-inch tap for connection of secondary air release valve. Secondary air release valve shall have a 1-inch inlet and 1/2 inch outlet. The body is to be constructed of cast iron according to ASTM A126, Grade B. A 1-inch gate valve shall be located between the secondary air release valve and the air and vacuum valve.

10. Manufacturer.

    a. Apco Valve and Primer Corporation, Model 1704-15.
    b. Val-Matic.
    c. Or equal.

C. **Air and Vacuum Valves**

1. Air and vacuum valves shall be properly sized and consist of cast iron body and cover, stainless steel float, tight closing seat with Buna-N seal.

    a. Internal parts, such as float guide, bushings, and baffle retaining screws shall be either stainless steel or bronze.
    b. Valves shall have threaded discharge.
    c. Manufacturers.
        1) Watts.
        2) Clow.
        3) Crispin.
        4) Val-Matic.

5) Or equal.

D. **Ball Valves**

1. V Port, Metal Seat.

   a. Body shall be carbon steel ASTM A216, Grade WCB with flanged ends.
   b. Valves rated for 150 psi working pressure unless noted otherwise in the Valve Schedule or on the drawings.
   c. Valve shall be standard port model with segmented ball. Ball shall be Type 317 stainless steel with tungsten carbide overlay, ASTM 351.
   d. Packing Gland shall be 317 stainless steel with tungsten carbide overlay, ASTM A351, Grade CGM with graphite seats.
   e. Flexible metal seat shall be 317 stainless steel with tungsten carbide overlay, ASTM A351
   f. Upper, Lower, and Thrust Bearings shall be reinforced PFTE fabric.
   g. Resilient seat shall be Reinforced PFTE.
   h. Lower shaft shall be 17-4 stainless steel, ASTM A564, H900 shaft.
   i. Manufacturer.
      1) Dezurik Model VPB V-Port Segmented Ball Valve
      2) Or equal.

2. Bronze
   a. Manufacturer. Subject to compliance with the specifications, provide the full-port valves from one of the following approved manufacturers.
      1) NIBCO (1/4 inch – 3 inches).
      2) Apollo (1/4 inch – 2 inches).
      3) Watts (1/2 inch – 2 inches).
      4) Milwaukee (1/4 inch – 2 inches).
   b. Performance. 600-pound-per-square-inch (psi), non-shock, cold working pressure.
   c. Materials.

Part	Material
Body	Bronze ASTM* B 584 Alloy C84400
Trim	Bronze or 316 stainless steel
Handle	Zinc-plated steel
Stem	Silicon bronze
Ball	Brass with hard chrome plate

   d. Fabrication and Assembly.
      1) Conforms to MSS SP-110.
      2) Full port.
      3) Blow-out proof stem.

3. Full Port, Steel Body Ball Valves, Resilient Seat.

a. Body shall be carbon steel ASTM A216, Grade WCB with flanged ends. Valves under 2" shall be threaded.
b. Valves rated for 150 psi working pressure unless noted otherwise in the Valve Schedule or on the drawings.
c. Valve shall be full port model Valve shall be standard port model with segmented body. Ball shall be Type 317 stainless steel with tungsten carbide overlay, ASTM 351.
d. Packing shall be multiple rings of polytetrafluorethylene (PTFE) or modified PFTE
e. Body seals, seats, stem seals shall be Ultra High Molecular Weight Polyethylene (UHMWPE) recessed in the machined body.
f. Bearings and Thrust Bearing shall be reinforced PFTE or polyfill.
g. Upper stem shall be Type 316 stainless steel, ASTM 479.
h. Manufacturer.
    1) McCanna – Marpac, J-Series Flanged Full Port Resilient Seat Ball Valve
    2) Worchester Series 82
    3) Metso Neles Series 9000
    4) Velan Split Body
    5) Trueline PN 20
    6) Clow
    7) Kennedy
    8) Or equal.

4. Polyvinyl Chloride (PVC).

a. Body shall be Schedule 80 true union, full port type constructed of thermoplastic PVC Type I, ASTM D1784 cell classification 12454.
b. Valves shall be a true union design with both socket and threaded end connectors.
c. Operators: Lever operated unless noted otherwise in Valve Schedule or on plans.
    1) Actuators: Electric actuators for PVC ball valves shall be 115 VAC with thermally protected, reversing motor in NEMA 4X rated enclosure. Actuator shall have manual override. Actuators shall be mounted in the factory and delivered as unit. Actuators shall be same manufacturer as valve.
d. Materials and construction
    1) Ball and valve Body: PVC
    2) Seat and seals: PFTE (Teflon with elastomeric backing cushions).
    3) Seals and O-rings: Viton
    4) Ends: Socket or Flanged
e. Manufacturer.
    1) Spears
    2) Chemtrol, Division of Nibco
    3) Hayward
    4) ASAHI America.
    5) Or equal.

5. 2-Way, Stainless Steel Ball Valves, 2-Inch and Smaller

a. Body shall be standard ball with circular, full port type constructed of Type 316 Stainless Steel for valves for air, water, and gas service.
b. Working pressure: 250 psi minimum, unless noted otherwise.
c. Valves shall be a threaded design with both socket and threaded end connectors.
d. Actuators: Electric actuators for PVC ball valves shall be 115 VAC with thermally protected, reversing motor in NEMA 4X rated enclosure. Actuator shall have manual override. Actuators shall be mounted in the factory and delivered as unit. Actuators shall be same manufacturer as valve.
e. Materials and construction
    1) Body, Ball and Stem: 316 SS
    2) Seats and Seals:
    3) Ends: Threaded
f. Manufacturer.
    1) Velan
    2) Or Approved Equal

E. **Butterfly Valves**

1. Cast Iron Body, Metal Seat.

a. Butterfly valves shall conform to AWWA C504, except as modified herein.
b. Valves shall be designed to comply with AWWA Class IV tight shutoff against a differential pressure of 150 psi.
c. The valve body shall be constructed of ductile iron as per ASTM A-126, Class B or cast iron with a minimum rated internal working pressure of 250 psi.
d. Valve body shall include a 316 stainless steel seat ring that is mechanically retained without use of clamping devices, adjusting segments, or other hardware being in the waterway.
e. Valve disc shall be flow through type with an off-set disc to allow for optimum Cv values, pressure responsive gasket, ductile iron. Resilient seat shall be located on edge of the disc, and shall seal against mating 316 stainless steel body seat with 360 degree uninterrupted contact.
f. The resilient seat shall be locked to the disc by a 316 stainless steel retaining ring and 316 stainless steel cap screws, and shall be field adjustable without any tools other than a standard socket wrench. Replacement of the seat in the field shall be possible without valve disassembly.
g. The shaft shall be Type 316 stainless steel with 316 stainless steel tapered pins for attachment of disc to shaft.
h. Internal and external bolts, fasteners, and other hardware including pins, set screws, studs, bolts, nuts, washers, and cap screws shall be 316 SS.
i. Both the operating and thrust shafts shall be Type 316 stainless steel.

j. Shafts seal shall be self-adjusting V-type chevron, Ethylene Propylene (EPT) or Buna S material.
k. Bushing shall have reinforced Teflon. Shaft Bearings shall be self-lubricating, sleeve type fiberglass with reinforced PFTE ling or florescent for valves small than 24-inch diameter.
l. Gear Actuator for Manual Valves
    1) Valves shall be provided with gear actuators conforming to AWWA C504.
    2) Gear actuators shall be constructed for minimum differential pressure of 25 psig.
m. Operators: Refer to Section 2.3 for gear operators and electric motor operators. Refer to Section 2.4 for requirements for manually operated valves including lever, handwheel, chainwheel, or T-wrench operators, or other valve accessories.
n. Manufacturer.
    1) Victaulic Masterseal - 300
    2) Valmatic American Model 2000,
    3) M&H Valve Company, Style 4500
    4) Or equal.

2. Cast Iron Body, Resilient Seat.

a. Conform to AWWA C504 except as specified herein. Valves rated for 150 psi working pressure unless noted otherwise in the Valve Schedule or on the drawings.
b. Body shall be cast iron ASTM A126 or ASTM A48 with planed ends or mechanical joint ends per valve schedule included in later in this section.
c. Disc shall be ductile iron ASTM A576 with 316 stainless steel seating edge.
d. Valves shall be designed for AWWA Class IV tight shutoff against a differential pressure of 150 psi.
e. Shaft shall be ASTM A276 Type 304 stainless steel
f. Body and stuffing box shall be ASTM A126, Class B cast iron. Shaft seals are self-compensating, and renewable, V-type packing with a minimum of four sealing rings.
g. Gland assembly shall be cast bronze ASTM B584.
h. Packing gland shall be housed in a solid-walled one-piece structure or approved equal. Packing shall be EPDM material.
i. Both ends of the shaft shall be integral with valve body.
j. Seats bonded or mechanically fastened on the discs are not acceptable.
k. Resilient seat material shall be Buna-N suitable for potable water or sewage or oil bearing liquids, and Viton or ethylene propylene terpolymer for air.
l. Handwheel or chainwheel operators shall be gear operated with position indicator. Lever operators shall include locks.
m. Buried valves shall have totally enclosed gear box with operator nut, valve box to finished grade, and extension stem. The gear housing shall have raised shoulder to fit valve box and exclude soil from entering valve box.
n. Manufacturers.
    1) Pratt, Series 2FII Bonded Seat 3”-20” valves

2) DeZurik BAW AWWA Butterfly Valves, 3”-20”
3) Or equal.

3. Cast Iron Body, Resilient Seated, Lug Style.

a. Valve shall only be used for air piping.
b. Body shall be of fully lugged construction.
c. Pressure rating shall be 225 psi.
d. Designed for bi-directional, drip tight shutoff up to a pressure of 150 psi.
e. Designed for installation between ANSI 125 or 150 pound flanges.
f. Flange holes shall be drilled to meet ANSI Class 125/150 dimensions.
g. Seat shall be of a one-piece design, molded to the valve body to fully line the body interior and to isolate the body from the flow media.
h. Disc shall be attached by the use of pins.
i. Stem seal shall be provided with adjustable packing gland.
j. Valve shall have body bearings to provide shaft support.
k. Materials of Construction.

1)	Body:	Cast Iron
2)	Disc Options:	Ductile Iron
3)	Shaft:	416 Stainless Steel
4)	Seat:	EPDM or Buna-N
5)	Body Bearings:	Bronze
6)	Stem Seals:	Same material as seat

l. Manufacturers.
1) DeZurik, BOS Lug Style
2) Pike Industries.
3) Keystone, Model 222 Lug Style
4) Bray.
5) Or Equal.

4. Anti-cavitation Trim.

a. Butterfly valves requiring anticavitation trim where indicated in the Valve Schedule shall include a stainless steel air distribution ring connected to the outside atmosphere via several radial holes in the valve flange.
b. Radial holes shall include isolation valves and an air/vacuum valve to prevent water from exiting the piping. The air/vacuum valve shall be as manufactured by Apco Valve and Primer Corporation or equal.
c. The trim shall admit air into the downstream side of the valve wherever low pressure exists.

F. **Check Valves**

1. Weight and Lever.

a. Cast iron body, bronze seat.

b. Seat shall be easily replaced without removing the valve from the line.
c. Disc shall be cast iron, suspended from a Type 316 stainless steel shaft.
d. The disc seat ring shall be resilient seated.
e. Grooved ends to fit AWWA C606
f. Flanged ends to fit 125-pound ANSI flanges.
g. Outside lever and weight that can be mounted on either side of valve, non-slamming and externally balanced.
h. Provide adjustable air closure on lever on valves larger than 6-inch diameter. Provide oil hydraulic, anti-slam closure device on all valves 12-inch and larger.
i. Drill and tap the bossed portion of the body of the valves and provide 304 stainless steel bracket for attachment of proximity switch on each valve to detect the closed position status of each valve. Provide a 115 VAC SPDT (N.C.) proximity switch with each valve.
j. All working parts removable through top of valve.
k. Valves 4 inches through 12 inches shall be rated for 175 psi working pressure, and valves 14 inches and larger shall be rated for 150 psi working pressure, unless noted otherwise.
l. Top blind connection shall be grooved couplings and blind cap for ease of maintenance operations.
m. Manufacturers.
    1) Victaulic Style 317
    2) McWane.
    3) American Flow Control.
    4) Milliken.
    5) Val-Matic.
    6) Or equal.

2. PVC, Ball Type.

    a. Style. True union, ball check.
    b. Construction.
        1) Body and Ball. PVC.
        2) Seat and Seals. EPDM.
    c. End Connections. Socket welded, unless otherwise specified in the Valve Schedule.
    d. Pressure Rating. 150 psi at 120 degrees Fahrenheit (°F.).
    e. Manufacturer.
        1) Chemtrol.
        2) Asahi/America.
        3) Or equal.

3. Double Door Type.

    a. Valve shall only be used for air piping.
    b. Valve shall be compact wafer design to fit between ANSI flanges.
    c. Doors shall be spring loaded, normally closed, by means of one or more heavy duty stainless steel torsion springs.

d. Flow from the blower shall cause the doors to open and upon blower shut-down the torsion spring will shut the doors before reverse flow starts and at a point of zero velocity, for non-slam closure.
e. Seating shall be Buna-N molded to the body and be resilient and watertight.
f. Valves 5-inches and larger shall be fitted with a lifting eye bolt for installation purposes.
g. Material of Construction.

1)	Body:	Cast Iron
2)	Doors:	Ductile Iron
3)	Sealing Element:	Buna-N
4)	Torsion Spring:	316 Stainless Steel
5)	Hinge Shaft:	316 Stainless Steel
6)	Stop Shaft:	316 Stainless Steel

h. Manufacturers.
   1) APCO.
   2) Crispin.
   3) Val-Matic.
   4) Or Equal.

4. Swing Flex Type.

a. Valves shall be full body type, with a domed access cover and only one moving part, the flexible disc per AWWA C-508.
b. Valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.
c. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be on a 45 degree angle to minimize disc travel.
d. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domes in shape to provide flushing action over the disc.
e. The disc shall be one-piece construction, precision molded with an integral o-ring type sealing surface, and contain alloy steel and nylon reinforcement in the flexible hinge area.
f. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.
g. The disc shall be precision molded Buna-N, ASTM D2000-BG.
h. Valves shall be equipped with manual backflush mechanism.
i. Manufacturers
   1) Val-Matic
   2) DeZurick
   3) Kennedy/McWane

5. High Performance Non-Slam

a. Manufacturers
   1) Crane Energy Duo Check
   2) Techno Check
   3) Or Equal

b. Valves shall be double flange retainerless wafer type dual-plate design

c. Performance. ANSI pressure class 150

d. Materials.

Part	Material
Body	Cast or Ductile iron
Seat	EPDM
Compression Spring	Type 316 stainless steel
Screws and Hardware	Stainless steel

6. Globe Style Silent

a. Manufacturer. Subject to compliance with the specifications, provide the globe valves from one of the following approved manufacturers.

1) Apco. Series 600 (3 inches – 42 inches).
2) Crispin. GC series (2 1/2 inches – 36 inches).
3) GA Industries. Series 280 (2 1/2 inches – 24 inches).
4) Milliken. Series 821 (2 inches – 24 inches).
5) Val-Matic. Series 1800 (2 inches – 48 inches).

b. Description. The valve shall be of the silent operating type that begins to close as the forward flow diminishes and is fully closed at zero velocity preventing flow reversal and resultant water hammer or shock.

c. Performance.

1) Minimum Rated Cold Working Pressure (CWP).

a) 2 Inch to 12 Inch. 200 psi.
b) 14 Inch and Up. 150 psi.

2) Designed to crack open at a minimum pressure of 0.5 psi.

d. Materials.

Part	Material
Body	Cast iron
Seat	Bronze
Disc or Plug	Bronze
Compression Spring	Type 302 or 316 stainless steel
Bushing	Bronze
Screws and Hardware	Stainless steel

e. Fabrication and Assembly.

1) The valve body shall have a flow area equal to the nominal pipe diameter at all points in the valve.
2) All component parts shall be field replaceable without special tools.

7. Ball Check Valves with Electric Hydraulic Operator
   a. All ball valves shall be of the tight-closing, shaft-mounted type that fully complies with the AWWA Standard C507. Manufacturer shall have a minimum of 15 years' experience in providing resilient seating systems for process valves, including hydraulic operators for process valves for automatic control of valves for flow, pipeline water hammer and surge control. The valve manufacturer shall have 15 years' experience providing hydraulically operator butterfly and/or ball valves of similar size and seat design for flow control in water service applications. Design pressure ratings shall be 150 psi and provide tight shutoff against flow in both directions. Design of valve shall be such that with the valve in the open position, the full and unobstructed circular inlet and outlet port diameter shall be as specified in Table 2 of AWWA Standard C507. With the valve in the closed position, the rubber seated valve shall be bubble tight at rated pressure.
   b. The valve body shall have integral support legs or mounting brackets cast into the body of the valve to provide a means to support the weight of the valve without interfering with the hydraulic operators. The valve body shall consist of a minimum of one piece and a center body piece through-bolted and O-ring-sealed against leakage. All body pieces shall be of cast iron ASTM A126 Class B. Minimum body thickness shall be as specified in Table 3 of AWWA Standard C507. Flanges shall be flat-faced and flange drilling shall be in accordance with ANSI B16.1 Class 125.
   c. The valve ball shall be constructed of ductile iron ASTM A536 65-45-12 or cast iron ASTM A48 Class 40, and shall be taper-pinned to an upper and lower fitted shaft of 18-8 Type 304 or 17-4 Type 630 stainless steel. Valves employing chromium-plated iron or steel shafts or trunnions shall not be accepted.
   d. The center section shall be fitted with sleeve-type bearings contained in the body hubs. Bearings shall be corrosion resistant and self-lubricating. material shall be Teflon-lined with fiberglass backing. Bearing surfaces shall be isolated from flow by O-ring type or lip type seals. The ball assembly shall be supported by a two-way thrust bearing assembly consisting of a stainless steel stud and thrust collar in a grease-packed cavity.
   e. The valve seats shall be one of the following designs:
      1) **Resilient seat in valve body with and stainless steel seats on the ball.** Seats shall be retained in the valve body by mechanical means without retaining rings, segments, screws or hardware of any kind in the flow stream. Seats shall seal a full 360° without interruption and have a plurality of grooves mating with a spherical stainless steel seating surface on the ball. Valve seats shall be field adjustable around the full 360°

circumference and replaceable without dismantling the operator, ball or shaft. Where line size permits, seats shall also be capable of being adjusted without removing the valve from the line. Manufacturer shall certify that the rubber seat is field adjustable and replaceable.

2) **Mechanically fastened seal with metal seats in valve body.** The resilient seal shall be locked to the ball of the valve. Resilient seats shall be located on the edge of the ball by a 316 stainless steel retainer ring and stainless steel cap screws, and field adjustable without any tools other than a standard socket wrench. Replacement of the seat in the field shall be possible with valve disassembly. Seat design shall be provide single bolt-through design to hold the retainer ring to the valve ball, with registers and serrations in the retainer and the ball to retain the seat and prevent outward movement of the seat. One set of additional seat assemblies shall be provided, including retaining ring and retention screws and 2 sets of resilient seats (total of 4) shall be provided. The warranty for seats attached to the ball shall be extended to two years, and include replacement of parts and any factory labor for repairs and service during the warranty period.

f. Valve shall be double seated and be factory certified drop tight at rated pressure.

g. Valve actuators shall conform to the operating requirements of AWWA C507 and shall be designed to hold the valve in any intermediate position between full open and fully closed without creeping or fluttering. Cylinder actuators shall move the valve to any position from the full open to the full closed position when a maximum of 100 psi or a minimum of 80 psi is applied to the cylinder. All wetted parts of the cylinder shall be corrosion resistant and cylinder rods shall be chromium-plated stainless steel. Cylinders furnished with enclosed operating mechanisms shall have all wetted parts constructed of non-metallic materials except the cylinder rod which shall be chromium-plated stainless steel. Rod seals shall be of the non-adjustable wear-compensating type. A rod wiper for removing deposits inside the cylinder shall be provided in addition to the external dirt wiper. Cylinder actuators of this type shall be Pratt MDT with Dura-Cyl cylinder, Val-Matic LSA Non-Metallic, or equal.

h. Valve actuator shall be equipped with a SPDT Open, Close & Momentary Rotary style limit switch assembly.

i. Pump Electric-Hydraulic Check Valve Control Panel

Each valve shall include a pump include a pump check control panel.

1) The control system for the pump check valve shall provide the following functions & be supplied by the valve manufacturer:

2) Independent adjustable rates of valve opening and closing operations.

3) Independent adjustable emergency closure rate resulting from an electric power failure or other operational signal eliminating power to the system.

4) The system shall be provided with a single solenoid four-way valve for the normal open and close function. Two solenoid operated two-way valves shall be provided for emergency closure, bypassing the single solenoid four-way valve. Separate adjustable speed control valves shall be furnished for open, close and emergency operation. The system shall be provided with a manual override for the normal open and close function.

5) The required speeds of operation shall be as follows:

Normal open
a) 60 seconds minimum
b) 300 seconds maximum
Normal close
c) 60 seconds minimum
d) 300 seconds maximum
Emergency close
e) 10 seconds minimum
f) 20 seconds maximum

6) The control system shall be fully piped and wired, and contained within a NEMA 4X cabinet with a hinged access door. All fittings and tubing shall be brass and copper. Electrical wiring shall terminate in a separate NEMA IV junction box within the control cabinet.

7) The pump check valve should be furnished with minimum of two (2) limit switches. One each for the full open or full closed positions, and the provisions for momentary interruption of the pump motor control to initiate pump shutdown prior to 100% valve closure to minimize hydraulic surge.

8) In addition to the pump check valve hydraulic controls, an electric control panel shall be supplied containing all necessary relays, timers, buttons and lights to interface the pump controls with the pump check valve controls. The panel shall provide for:

a) Visual indication of valve position with red and green indicating lights.
b) Visual indication of alarm conditions with amber flashing light.
c) Emergency shutdown of pump and valve by an external button.
d) Pump system lockout after an alarm condition. System to be started again only after the reset button is pressed.

f. The alarm function of the panel shall include an adjustable solid state timing relay, lockout relay, flashing light and reset button. The controls shall be housed in a continuous hinge NEMA 4

cabinet suitable for wall mounting. Each alarm relay shall have a set of contacts wired to the terminal strip for remote indication.

g. All ball valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in Section 5.2 of AWWA Standard C507.Certified shop test reports shall be submitted is requested by the Engineer.\

h. Lining and Coating.

1. The manufacturer shall line all internal cast or ductile iron surfaces, except finished or bearing surfaces, with Ameron Amercoat 370 epoxy to a thickness of 8 mils minimum.
2. All exterior steel or cast or ductile iron surfaces of each valve, except finished or bearing surfaces, shall be shop coated with Ameron Amercoat 370 epoxy to a thickness of 8 mils minimum.
3. Fusion bond epoxy coatings of inside and outside of the valve can be provided in lieu of epoxy coating listed under items 1 and 2 above. Fusion bond coating be NSF approved with a thickness of 8 mils fusion bonded epoxy per AWWA C550 standards.

l. Manufacturer.

1. Val-matic Valve and Manufacturing Corp Ener-G Ball Valve and Electric-Hydraulic Operator
2. Alternate Bid Equipment
   a. Henry Pratt Company Ball Check Valve Diagnostic Electro-Check (Base Bid)
   b. Or equal

G. **Corporation Stops**

1. Type 1.

a. Standard. AWWA C800.
b. Material. Bronze.
c. End Connection.
   1) Inlet. AWWA taper thread.
   2) Outlet. Threaded, inside iron pipe.
d. Manufacturer and Model.
   1) Mueller Co., Model H10045.
   2) Ford Meter Box Co., Model FB1600.
   3) Or equal.

2. Type 2.

a. Standard. AWWA C800.
b. Material. Bronze.
c. End Connection.
   1) Inlet. AWWA taper threaded.
   2) Outlet. Flared copper.
d. Manufacturer and Model.
   1) Mueller Co., Model H15000.
   2) Ford Meter Box Co., Model FB600.
   3) Or equal.

H. **Curb Stops**

1. Type 1.

   a. Standard. AWWA C800.
   b. Material. Bronze.
   c. End Connection.
      1) Inlet. Threaded, inside iron pipe.
      2) Outlet. Threaded, inside iron pipe.
   d. Manufacturer and Model.
      1) Mueller Co., Model Oriseal Mark II H10287.
      2) Or equal.

2. Type 2.

   a. Standard. AWWA C800.
   b. Material. Bronze.
   c. End Connection.
      1) Inlet. Flared copper.
      2) Outlet. Flared copper.
   d. Manufacturer and Model.
      1) Mueller Co., Model Oriseal Mark II H15154.
      2) Ford B22-666M.
      3) Or equal.

I. **Gate Valves**

1. 2-1/2 Inches and Smaller.

   a.Bronze Body.
      1) Minimum 125-psi working pressure.
      2) All bronze, rising stem, double disc, or wedge type.
      3) Handwheel operator.
      4) Manufacturers.
         a) Crane.
         b) Or equal.

2. 3 Inches and Larger.

   a. Iron Body, Double Disc.
      1) Shall be in conformance with AWWA C500.
      2) Iron body, bronze mounted with bronze wedge and pin.
      3) Full pipe area circular opening.
      4) Minimum 150-psi working pressure, unless noted otherwise.
      5) Valves with handwheel shall be outside screw and yoke type.
      6) All valves without handwheels shall be nonrising stem type.
      7) Manufacturers.
         a) American Darling.
         b) Or equal.

3. Resilient Wedge.

a. Iron Body.
1) Shall be in conformance with AWWA C509.
2) Iron body, cast iron wedge with rubber seat permanently bonded to and encasing the wedge.
3) Rubber bonding process in conformance with ASTM D 429.
4) Rubber seat shall be polyurethane, SBR, or Buna-N, nick free, resilient, and abrasion resistant.
5) Minimum 150-psi working pressure, unless noted otherwise.
6) Valves with handwheel shall be outside screw and yoke type.
7) All valves without handwheels shall be nonrising stem type.
8) Manufacturers.
a) American Darling.
b) Mueller.
c) Clow
d) Kennedy
e) Or equal.

J. **Knife Gate Valves**

1. Valves shall be of the knife gate valve type, rated for 150 psi. Flanges shall be drilled and tapped to ANSI B16.5, 150-pound standard with raised faces. Flange raised face shall be machined using serrated-spiral or serrated-concentric grooves with 125-250 RMS finish. Valve bodies shall be cast 316 stainless steel.

2. Valves shall have 316 stainless steel gate, and integral cast stainless steel seat. The gate shall be of a design and thickness to withstand full 150 psi rated pressure without permanent deflection to the gate. Gate shall have rounded, beveled bottom. Seat and gate shall of a fully machined finish for one-way shutoff. A minimum of two gate wedges shall be provided to assist seating the gate against the seat in the lower half of the valve body. Gate guides shall be provided in the upper half of the valve body.

3. Packing gland shall be cast stainless steel and shall have an adequate number of gland bolts to provide even tightening of the packing material by the packing gland. Packing shall be Teflon lubricated synthetic packing with a minimum of 4 rows. Packing gland bolts, studs and nuts shall be 304 stainless steel.

4. Valve yoke shall be cast 304 stainless steel. The yoke shall be the flat top design to allow bolt-on field installation or conversion of actuators without welding or machining. The valve stem shall be 304 stainless steel with full ACME threads. Stem nut shall be bronze. Stem nut shall be enclosed using a cast 304 stainless steel retainer.

5. Valves shall be designed, manufactured, and tested to AWWA C520 standard.

6. Manufacturer. Subject to compliance with the specifications, provide the valves from one of the following approved manufacturers.

   a. Pratt.

   b. Hilton Fabricated Valves.

   c. Orbinox.

   d. Or Approved Equal

K. **Mud Valves, Stainless Steel**

1. Manufacturer. Subject to compliance with the specifications, provide the stainless steel mud valves from one of the following approved manufacturers.

   a. Trumbull (4 inches – 12 inches).
   b. Troy Valves (4 inches – 12 inches).
   c. Fontaine Series 85 (4 inches – 24 inches).

2. Materials.

Part	Material
Body, Flange, Yoke, Gate	Cast Type 316 stainless steel or welded Type 316L stainless steel
Resilient Seat	Neoprene or BUNA
Fasteners	Type 316 stainless steel
Stem	Type 316 stainless steel

3. Fabrication and Assembly.

   a. Nonrising stem.
   b. 3/4-inch minimum flange thickness.

L. **Plug Valves**

1. Eccentric, nonlubricated.

   a. Body shall be iron or semi-steel.
   b. Valves rated for 150 psi working pressure unless noted otherwise in the Valve Schedule or on the drawings.
   c. Port opening shall 360 degree round port with same ID as adjoining pipe to ensure best possible Cv values or rectangular port.
   d. Buna-N coated, tight sealing plug.
   e. Buna-N seats, except Viton or ethylene propylene terpolymer (EPT) for air service.
   f. Top and bottom bearings of noncorrosive material.

g. All buried valves and valves 6 inches and larger shall have enclosed gear operators.
h. Manufacturers.
1) Victaulic Style 365
2) Clow.
3) DeZurik.
4) Homestead.
5) Val-Matic.
6) Or equal.

2. Full Port.

a. Body and Cover. Valve bodies and covers shall be cast iron ASTM A 126, Class B and Bi-Directional
b. Valves rated for 150 psi working pressure unless noted otherwise in the Valve Schedule or on the drawings.
c. Plug. Valve plugs shall be cast ASTM A 126, Class B or ductile iron. The entire plug face shall be covered with Buna N rubber compound.
d. Seat Ring. Seat rings shall be solid, one-piece, raised surface seat of welded nickel or 304 stainless steel to conform to plug face.
e. Packing. Multiple ring v-type packing material shall be self-adjusting and renewable.
f. Bearings. Sleeve type bearings shall be utilized in both the upper and lower trunnions. Bearing material shall be stainless steel or PFTE phenolic backed Teflon.
g. Manufacturer.
1) Victaulic Style 365 360 round port ID match
2) Dezurik Model PEF 100% Port Eccentric Plug Valve.
3) Valmatic Model 5600R (Flanged) or 5700R (MJ)
4) Or equal.

M. **Pressure-Reducing Valves**

1. Pressure-reducing valves shall be hydraulically operated, pilot controlled, diaphragm type globe valve.

a. Valve shall maintain an adjustable downstream pressure regardless of fluctuations in flow rate and shall close tight when a pressure reversal occurs.
b. Valve shall have a single removable seat and resilient disc.
c. Pilot control shall be direct acting, adjustable, spring loaded, normally open diaphragm valve, designed to permit flow when controlled pressure is less than spring setting.
d. Valve shall have iron body with bronze trim.
e. Manufacturers.
1) Watts.
2) Fischer
3) Cla-Val
4) Or equal.

N. **Pressure-Relief Valves**

1. Hydrostatic.

    a. Valves shall be designed to operate on a hydrostatic differential.
    b. Floor type valves shall be cast iron body with resilient seat.
    c. Wall type valves shall be flanged, cast iron body, bronze mounted, with resilient seat.
    d. Valves shall come complete with corrosion resistant strainer, strainer plug, and tapped flange wall pipe.
    e. Manufacturers.
        1) Clow.
        2) Or equal.

O. **Control Valves**

1. **Manufacturer**. Subject to compliance with the specifications, provide the control valves from one of the following approved manufacturers (available diameters in parentheses).
    a. Bermad (Globe: 1-1/2 inches to 32 inches; Angle: 1-1/2 inches to 18 inches).
    b. Cla-Val (Globe/Angle: 1-1/4 inches to 24 inches).
    c. GA Industries (Globe/Angle:).
    d. Ross Valves (Globe/Angle: 4 inches to 48 inches).
    e. OCV Control Valves (Globe: 1-1/4 inches to 24 inches; Angle: 1-1/4 inches to 16 inches).

2. The main valve shall be a hydraulically operated, single diaphragm or piston actuated, globe or angle pattern valve as specified in the Valve Schedule.

3. Pressure Relief/Pressure Sustaining Valve.

    a. Description.

        1) The valve shall maintain a constant upstream pressure by bypassing or relieving excess pressure and shall maintain close pressure limits without causing surges.
        2) If upstream pressure decreases below the spring setting, the valve shall close.
        3) Closing speed shall be field adjustable.

    b. Adjustment Range. The valve pressure setting shall be field adjustable from 20 to 200 pounds per square inch (psi).

4. Pressure Reducing Valve.

    a. Description.

        1) Automatically reduces a higher inlet pressure to a constant lower outlet pressure regardless of changing flow rate and/or varying inlet pressure.
        2) Closing and opening speeds shall be field adjustable.

b. Adjustment Range. The valve pressure setting shall be field adjustable from 20 to 175 psi.

5. Pump Control Valve.

a. Description.

1) Solenoid operated pump control for controlled opening and closing on pump start-up and shut-down.
2) Equip with mechanical lift check feature to close valve the moment flow stops, preventing reverse flow.
3) Valve and pump operations are interlocked by a limit switch assembly.
4) Opening and closing speeds shall be field adjustable.

6. One Way Altitude Valve.

a. Description.

1) Provides automatic filling of elevated tanks or reservoirs.
2) When the altitude control senses a drop in level below the predetermined set point the valve opens to fill tank.
3) Discharge of the tank is by a separate line.

b. Adjustment Range. Field-adjustable from 50 to 200 feet.

7. Two-Way Altitude Valve.

a. Description.

1) Provides automatic filling of elevated tanks or reservoirs.
2) When the altitude control senses a drop in level below the predetermined set point the valve opens to fill tank.
3) Valve closes when level set point in tank is reached.
4) Tank filling and discharge are both through the valve.

b. Adjustment Range. Field-adjustable from 50 to 200 feet.

8. Surge Anticipator Valve.

a. Description.

1) Used in pumping systems to protect equipment from damaging pressure surges or waves caused by rapid changes of flow within the pipeline.
2) Responds by opening at a preset low pressure setting, allowing for quick relief of the returning high pressure wave.
3) Remains open as the integral accumulator is charged and then closes.

4) This prevents possible excess system drainage should pressure not return to/above the low pressure setting.
5) Equip with a high pressure control pilot which allows for high pressure relief service.
6) Opening speed, closing speed, and full open timing shall all be field adjustable.

b. Adjustment Range. Low and high pressure settings shall be field adjustable from 20 to 200 psi.

9. Flow Control Valve.

a. Description.

1) Maintains a constant flow rate, adjustable, regardless of fluctuations in line pressure.
2) The rate of flow pilot senses the differential pressure across a thin edged orifice plate mounted in the valve inlet flange.
3) It responds to changes in pressure and modulates the main valve to maintain the desired flow.
4) The closing and opening speed shall be field adjustable.

10. **Performance**

a. The top of the valve shall allow any necessary repairs to be made while the body remains in line.
b. Minimum working pressure is 250 pounds per square inch (psi).

11. **Materials**

Part	Materials
Diaphragms and Seals	Buna-N
Body and Cover	Ductile iron ASTM* A 536
Internal Cast Components	Ductile iron or CF8M (316) stainless steel or bronze
Piston Guiding and Sealing Surfaces	Bronze
Pilot Valves	Bronze
Tubing	Copper
Tubing Fittings	Bronze
Valve Seat and Disc Guide	Stainless steel

*ASTM – American Society for Testing and Materials

12. **Fabrication and Assembly**

a. Diaphragms shall not seal directly against the valve seat and are fully supported by the valve body and cover.

b. Line and coat all ductile iron components, including the body and cover, with an NSF 61-certified epoxy coating applied by the electrostatic heat fusion process.

c. If installed, the disc and diaphragm assembly shall be securely retained on 3-1/2 sides by a disc retainer and disc guide. The exposed portion of the seal shall contact the valve seat and seal drip-tight. The disc and diaphragm assembly must be guided by two separate bearings, one installed in the valve cover and one concentrically located within the valve seat, to avoid deflection and assure positive disc-to-seat contact.

d. If installed, the valve piston shall be fully guided on its outside diameter. To minimize the consequences of throttling, throttling shall be by long, stationary vee-ports located downstream of the seat and not by the seat itself.

e. Valve shall have a full bore opening through the valve with no obstructions in the flow path.

f. Pilot Valves and Tubing.

1) Factory-assemble each valve with all necessary control valves, tubing, and fittings to perform its specified functions as described below.
2) All tubing connections to main valve body shall include isolation cocks.
3) Each valve assembly shall include a y-strainer upstream of any pilot valves.

P. **Telescoping Valves**

1. Materials.

Part	Material
Stem Guides	UHMW polyethylene
Lifting Nut	Manganese bronze
Fasteners	Stainless steel
Lifting Bail	316 stainless steel
Flange	Stainless steel
Gasket Seal	Neoprene
Tube, Baffle	304 stainless steel
Stem	Stainless steel

2. Fabrication and Assembly.

a. Nonrising stem type with vertical threaded screw operation.

b. Smooth round tube with notched weir.

c. Threaded screw type stem.

d. Floor stand either straight or offset as shown on drawings with grease fittings and travel indicating device geared down to indicate the full travel on a reduced scale.

e. Flange drilled with only sufficient clearance to allow the tube to pass and provided with neoprene gasket seal to connect to the withdrawal pipe.

f. Handwheel operation to raise and lower tube. Maximum number of handwheel turns for 1 foot of tube travel shall not exceed 16.

g. Fabricated baffle attached to tube with tube weir located at the midpoint level of the baffle. Construction and materials for baffle as shown on the drawings. Provide baffle as indicated in the Valve Schedule.

h. Manufacturers.

1) H. Fontaine, Ltd.
2) Halliday Products.
3) Latanick Equipment, Inc.
4) Troy Valve.
5) Waterman Industries, Inc.
6) Whipps, Inc.

Q. **Yard Hydrants**

1. Type 1 - Nonfreeze, Post Type, Hydrants with 2-inch Hose Nozzle.

a. Connection.
1) 2-inch iron pipe straight inlet thread, universal type.
2) 2-inch outlet thread nozzle, 11-1/2 threads per inch.

b. Materials.
1) Stock and Base. Cast iron.
2) Top, Slide, and Handle. Cast iron.
3) Nozzle, Nipple, Screw, and Tee. Brass.
4) Valve Body, Stem, and Ring. Brass.
5) Washers. Leather.

c. Required Features.
1) Handle. Ball wheel.
2) Field serviceable without digging up hydrant.
3) 2-inch size Andrews cam and groove, male adapter with 2-inch female end threaded with National Pipe Taper Threads, 11-1/2 threads per inch. Male adapters shall be brass, Type A, part No. 200-A, as manufactured by the Dixon Valve and Coupling Company. Provide and install one male adapter on each yard hydrant installed.
4) 2 inch Andrews can and groove, reducing coupler, with 1 1/2 inch male end threaded with American Standard Taper Threads, 11-1/2 threads per inch. Reducing coupler shall be aluminum, part No. 2015-B, as manufactured by Dixon Valve and Coupling Company. The male threads shall be compatible with 1-1/2-inch

iron pipe hose threads, 11-1/2 threads per inch. Provide one reducing coupler for every yard hydrant installed.

d. Depth of Bury. As shown on drawings.

e. Manufacturer and Model.

1) For Flushing Water. Murdock Model M-200.

2) Or equal.

2.3 OPERATORS

A. Manual

1. Shall be enclosed gear or traveling nut type as noted in the Valve Schedule with no external moving parts.
2. Operating force shall not exceed 40 pounds.
3. Provide chainwheel operators on manually operated valves more than 60 inches (1500 mm) above floor. Extend chains to 36 inches (900 mm) above finished floor elevation. Where valves are above aisles, provide 1/2-inch stainless steel hook bolt to tie chains to sides to keep chain out of walking area. See Paragraph 2.4. J Chainwheel Operators in these specifications for additional requirements.

B. Electrical

1. General. The electric operators shall conform to the following specifications. The operator shall be the open or close only type (O/C) or modulating type (MOD) as specified. Modulating type operators shall be designed to hold the valve in the intermediate position between fully open and fully closed without creeping or fluttering.

2. Drive Motor. Drive motor shall be of sufficient size to open or close valve against maximum differential pressure when voltage to the motor terminals is 90 percent of nameplate rating. Drive motor shall be specifically designed for operator service and shall be of totally enclosed, nonventilated construction, with permanently lubricated ball bearings. Drive shall have Class F insulation. The drive motor shall be provided with a thermostatically controlled heater. The power source to the motor shall be 120 volt,1 phase or as shown on Contract Drawings. Provide thermal switches, embedded in motor windings to protect against overheating. Provide NEMA 4X enclosure.

3. Limit Switches. Limit switches and the limit switch drive mechanism shall be an integral part of operator. Limit switches shall be adjustable, allowing for trip points from fully open to fully closed positions of valve travel. Limit switches shall be geared to, and actuated by, the driving mechanism whether in motor drive or manual (handwheel) operation. Operator shall have provisions for mounting at least eight (four N.O., four N.C.) additional limit switches which shall be housed in an integral housing to the operator. Limit switch compartment to have no exposed electrical connections. Use proximity style limit switches wherever possible. Provide a NEMA Type 4X enclosure.

4. Torque Switches. Each operator shall have an opening torque switch and a closing torque switch. Torque switches shall have a range of

adjustment and be responsive to opening or closing loads such that switches operate to protect valve and operator from damage when there is valve obstruction during opening or closing.

5. Handwheel and Declutching Mechanism. Declutching mechanism shall operate valve by means of permanently attached auxiliary handwheel. Declutch assembly and handwheel may be used to operate valve when electrical power is not available. Handwheel shall require no more than 40 pounds of rim pull. Actuation of motor shall automatically return the operator to the electric mode. Handwheel is not to rotate while operator is in the electric mode. Electric mode can be overridden locally by holding declutch lever down and rotating handwheel manually.

6. Motor Controller. A NEMA or IEC rated reversing motor controller with either overload relays in each phase or a thermal relay responsive to motor winding temperature, or both, shall be provided. Each opening and closing contactor shall be equipped with auxiliary contacts and mechanical linkages such that controller shall be electrically and mechanically interlocked. Controller shall be completely wired to 600 volt terminal blocks or plug assemblies in a minimum NEMA 4 or ingress protection (IP) 65 rated housing which is integral to operator. Valve travel time shall be 60 seconds from the fully open to fully closed position. All internal wiring in the housing shall be to terminal strips or plug assembly, and all limit and torque switches shall be wired to these terminals. Include a control transformer with a minimum volt-ampere rating of 2.5 times the volt-ampere load of the motor contactor coil. The control transformer shall have fuse protection on the primary and secondary side circuits.

7. Open-Close Operators (O/C). The valve control shall be provided with local switches for local/remote and open/stop/close operation. The local switches shall be provided on the limit switch compartment. A mechanical dial for local position indication shall be provided.

8. The local switches shall be provided on the limit switch compartment. A mechanical dial for local position indication shall be provided.

9. Modulating Requirements. Modulating operators shall include a proportional position servo amplifier. The proportional position servo amplifier shall be designed to accept a 4-20 milliamperes direct current (mAdc) input signal. The unit shall contain the following control functions.

    a. Span. This function shall calibrate the position feedback potentiometer to cause the full rotation of the output shaft to correspond to the full 0 to 100 percent range of the signal from the set point controller.
    b. Zero. This function shall calibrate the position feedback potentiometer to cause the travel of the output shaft to be properly centered.
    c. Gain. This function shall control the rate at which the motor speed increases as the error signal increases.

d. Dead Band. This function shall control the magnitude of error signal that occurs before the motor begins to rotate to prevent hunting.

The control module shall be furnished with two feedback potentiometers for use in balancing the control circuit and for remote indication. The position feedback potentiometer shall be provided with antibacklash gearing or shall be operated directly from the valve shaft as required to minimize hysteresis to within 1 degree. Modulating type electrically operated valve shall include valve position transmitter. The output signal from the valve position transmitter shall be 4-20 mAdc. The valve control shall be provided with selector switches to allow local open/close operation or automatic modulating control from the remote 4-20 mAdc signal. The selector switches shall be provided on the limit switch compartment. A mechanical dial for local position indication shall be provided.

10. Local Controls. The valve control shall be provided with local switches for local/remote and open/stop/close operation. The local switches shall be provided on the limit switch compartment. A mechanical dial for local position indication shall be provided. The valve operator shall be provided with an integral ON-Off power switch. Provide illuminated indicating lights to display current status. Provide auxiliary contracts for valve FAULT and LOCAL-OFF-REMOTE switch status.

11. Gear Box Assembly. Gear box is to be completely filled with lubricant, allowing operator to be installed in any position. Operator design shall accommodate removal of motors without loss of lubrication.

12. Manufacturer.
    a. Auma

13. Alternate Bid Equipment:
    a. Rotork IQ Multi-turn or IQT Quarter Turn Valves
    b. Limitorque
    c. E.I.M.
    d. Or equal.

2.4 ACCESSORIES (All Valves Except Sluice Gates)

A. Valve Boxes

1. All buried valves shall be provided with valve boxes.

2. Valve boxes shall be standard, adjustable, heavy pattern, cast iron extension type, three piece, screw type, and with 5 1/4 inch inside diameter.

3. Valve boxes shall be of sufficient length to extend from valve to finished grade.

4. Tops shall be set at established grades and valve box cover shall be marked with pipe function.

Valve Size	Base
4" and smaller	round, 8" in height, 10-7/8" diameter at bottom
6" and 8"	round, 11" in height, 14-3/8" diameter at bottom
10" through 16"	oval, 9-1/2" in height, 21" by 12-1/2" diameter at bottom
18" and 20"	oval, 10" in height, 25-1/2" by 16" diameter at bottom
24"	dome, 5" in height, 15" diameter and 17" square flange at bottom

B. **Curb Boxes**

1. Type 1.

    a. Type. Cast iron, extension type, Minneapolis Pattern.
    b. Size. Inside diameter of upper section shall be 2 inches.
    c. Provide stationary rod, lid, and plug.
        1) The stationary rod shall extend to 6 inches below finish grade.
    d. Manufacturer.
        1) Mueller H-10304.
        2) Or equal.

2. Type 2.

    a. Type. Cast iron, Buffalo type.
    b. Size. Inside shaft diameter shall be 2 1/2 inches.
    c. Provide lid.
    d. Manufacturer.
        1) Mueller H-10350, size 93-E.
        2) Star 94E.
        3) Or equal.

C. **Floor Boxes**

1. Floor boxes shall be cast or ductile iron construction with cover.
2. Floor boxes shall be of the bronze bushing type.
3. Boxes shall be designed for installation in floors and slabs as shown.
4. Include with all valves where operating nut is at concrete slab.

D. **Floor Stands**

1. Floor stands shall be cast iron or ductile iron, right angle type, crank operated, straight or offset as required, and rigidly anchored, and shall include position indicator for open and field set full close position.
2. Floor stands shall be nonrising type unless noted otherwise.
3. Operators shall turn counterclockwise to open.
4. Single or double gear reduction shall be provided as required.
5. Antifriction bearings shall properly support both opening and closing thrust to floor stand.
6. Floor stand shall operate the valve or gate under all operating conditions with 40 pound maximum pull on the crank.

7. All components shall be enclosed in a cast iron or ductile weatherproof housing with positive mechanical seals to exclude moisture and dirt and prevent lubricant leakage.
8. Lubrication fittings shall be furnished for all gears and bearings.
9. Floor stand pedestal shall position the input shaft approximately 30 inches above the base.
10. A permanently attached or cast arrow with the word "OPEN" on the floor stand shall be furnished indicating the direction of rotation to open the valve or gate.
11. Floor stands shall be suitable for occasional submergence.

E. **Extension Stems**

1. Constructed of extra strength steel rod for buried valves and Type 304 stainless steel rod for the stems inside structures and buildings.
2. Length shall be as required for proper operation of the valve or as specified in the valve schedule.
3. Extension stems shall be securely fastened to the valve stem.
4. Extension stems for buried valves shall extend to within 3 1/2 feet of finished grade unless noted otherwise.

F. **Stem Guides**

1. Constructed of cast iron or stainless steel with bronze bushing.
2. Guide shall be of adjustable design for plumb alignment.
3. Guide shall be complete with stainless steel anchor bolts.
4. Spacing as required to support stem but shall not exceed 10 feet.

G. **Operating Nuts**

1. Operating nuts shall be provided for all valves and as called for in the Valve Schedule.
2. All buried valves shall have operating nuts.
3. All operating nuts shall be 2 inches square.

H. **Lever Type Operators**

1. For valves located less than five feet above operating floor, provide levers on four-inch diameter or smaller, quarter-turn valves, and provide handwheels on all other valves, unless otherwise shown or specified.
2. Lever operators are only applicable to manual operation of one-quarter valves under 4 inch diameter that satisfy maximum allowable 40 pound pull force needed to unseat and operate valve. Lever shall be capable of being fixed in any intermediate position.

I. **Handwheel Operators**

1. Conform to applicable AWWA standards.
2. Material of Construction: Ductile iron, or cast aluminum.
3. Arrow indicating direction of opening and word “OPEN” shall be cast on trim of handwheel.
4. Maximum handwheel diameter: 2.5 feet.
5. Manual operators shall be enclosed gear or traveling nut type with hand wheel as noted in the Valve Schedule with no external moving parts.
6. Operators shall be sized for 40 pound pull force.
7. Provide chain wheel and chain for valves where centerline of valve stem is greater than five (5) feet above floor.

J. **Chain Wheel Operators**

1. Install chain wheel operators on manually operated valves more than 60 inches (1500 mm) above floor shall be equipped with chain wheel operators. Extend chains to 36 inches (900 mm) above finished floor elevation. Where valves are above aisles, Provide 1/2-inch stainless steel hook bolt to tie chains to sides to keep chain out of walking area.
2. Chain wheel and chain guides shall be cast from Type 316 investment casting stainless steel and passivated in accordance with ASTM A-389 after burrs and sharp edges are removed. Chainwheel shall be recessed groove, pocket type made out of Type 316 stainless steel. Chain wheel shall be direct mounting to valve stem with adapter or pinned to valve stem.
3. Provide welded link chain of Type 316L stainless steel with smoke smooth, Chain that is crimped or has links with exposed ends is unacceptable.
4. Provide geared operators where required to position chainwheels in vertical.
5. Provide secondary restraint to protect personnel operating an overhead valve in the event the chainwheel should separate from the valve and fall to the ground. The Components shall be 316 SS including eyebolt, wire rope cable, and cable clips. A locking jam nut shall secure an eyebolt threaded into the top half of the chainwheel guide. Manufacturer shall provide test results demonstrating the restraint shall be capable of supporting 200 pounds from of fall of 4 feet above. Restraint shall be manufactured by Trumbull Industries, Youngstown, OH or approved equal.

K. **Valve Wrenches**

1. Wrenches shall be of T-bar design with socket.
2. Length shall be sufficient to comfortably operate valves.
3. See Valve Schedule for quantity but provide at least one fixed bar type and one sliding bar type for close quarters.

L. **Portable Electric Operator**

1. Operator shall be reversible for raising and lowering and shall be furnished with a 15-foot electric cord.
2. Operator shall be adjustable from 34 inches to 44 inches from the base of a tripod stand to the operating socket.
3. Operator shall be suitable for 120-volt, single-phase, 30-amp service, and sufficient torque to operate sluice gate.
4. An overload release clutch shall be provided to release instantly at a preset, predetermined torque.
5. Manufacturers.

    a. Rodney Hunt Company.
    b. Waterman Industries, Inc.
    c. Wachs.
    d. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Inspection**

1. Verify job conditions and intended valve service before ordering each valve.
2. Inspect for damage to valve resulting from shipping and handling prior to installation.
3. Remove debris from inside piping system before installation.

3.2 PREPARATION

A. **Handling**

1. Handle valves and accessories with care.
2. Comply with the manufacturer's instructions.

3.3 INSTALLATION

A. **Procedures**

1. Install in accordance with manufacturer's instructions.
2. Install operators for most convenient access. All valve operator access shall be located only after coordinated with the Owner's operation personnel and the Engineer/Architect.
3. Install plumb and level.
4. Install free from distortion.
5. Install with proper support and restraint.

3.4 **FIELD QUALITY CONTROL**

A. **Inspection**

1. Verify conformance with manufacturer's shop drawings.
2. Verify conformance with manufacturer's instructions.
3. Report defects in workmanship, materials, and performance.

3.5 **ADJUSTING**

A. **Procedures**

1. Follow manufacturer's instructions.
2. Adjust stops and friction clamps for proper operation.

3.6 **DEMONSTRATION**

A. **General**

1. Demonstrate proper operation under actual service conditions.
2. Valves that have moving internal mechanisms designed to operate without manual operation shall have functions demonstrated for a minimum of three repeat cycles. This includes air release valves, air and vacuum breaker valves, pressure reducing valves, back pressure valves, check valves, pressure relief valves, surge anticipator, and surge relief valves.
3. All valves shall be demonstrated to not leak under maximum design operating pressures when operated for a minimum of three repeat cycles of open and close during the operational demonstration period.

3.7 **MAINTENANCE**

A. **Contractor's Responsibility**

1. Conform to manufacturer's recommended procedures.
2. Provide initial lubrication and maintenance.
3. Perform maintenance until the installation is accepted by the Owner.

PART 4 - VALVE SCHEDULE

4.1 **GENERAL**. The Valve Schedule is for the convenience of the Contractor and the omission of any valve does not release the Contractor from the responsibility to furnish and install all the valves required by the drawings.

4.2 **SIZES**. Only valves 3 inches and larger are included in the Valve Schedule. Valves integral to or specified with other equipment, valves bid as part of unit price items, and valves to be furnished under plumbing, heating, or other sections of the specifications are not included.

4.3 **VALVE WRENCHES**. Provide six valve wrenches. Three wrenches shall be fixed bar type and three shall be sliding bar type.

4.4 ABBREVIATIONS

A. Valves and Gates

AR	Air Release
AV	Air and Vacuum Valve Assembly
BA	Ball Valve
BF	Butterfly Valve
CK	Check Valve
CA	Combination Air Valve
CS	Curb/Corporation Stop
FM	From Equipment Manufacturer
GA	Gate Valve
MU	Mud Valve
PR	Pressure Relief Valve
PRV	Pressure Reducing Valve
PL	Plug Valve
TS	Telescoping Valve

B. Operators

CW	Chain Wheel
EL	Electric
ES	Extension Stem
HC	Hand Crank
HW	Hand Wheel
HY	Hydraulic
LE	Lever
LW	"L" Wrench
ON	Operating Nut
PN	Pneumatic
FS	Floor Stand

C. Ends

FL	Flange
GR	Grooved
LG	Lug
MJ	Mechanical Joint
PO	Push On
SC	Screw

4.5 **ATTACHMENTS**

A. **Air Valve Schedule**

Location	Service	Type	Size (Inches)	Quantity	Installation	Minimum Closing Pressure (psi)	Inlet Diameter (Inches)	Outlet Diameter (Inches)	Outlet Orifice Size (Inches)	Body Type	NSF 61 Compliance
WF#1 (101)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#2 (111)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#3 (121)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#4 (131)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#5 (141)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#6 (151)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#7 (161)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#8 (171)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#9 (181)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
WF#10 (191)	NPW	AV	2	1	OD	<1	2	1	NA	DB	Y
ERMV (208)	NPW	AR	2	1	VA	<1	2	1	NA	SB	Y
WAB (301)	NPW	AR	2	1	PL	<1	2	1	NA	SB	Y
FWEV (224)	CW	CV	2	1	VA	<1	2	1	NA	SB	Y
HSP1 (513)	CW	AV	2	1	PL	<1	2	1	NA	SB	Y
HSP2 (523)	CW	AV	2	1	PL	<1	2	1	NA	SB	Y
HSP3 (533)	CW	AV	2	1	PL	<1	2	1	NA	SB	Y

HSP4 (543)	CW	AV	2	1	PL	<1	2	1	NA	SB	Y
HSP5 (553)	CW	AV	2	1	PL	<1	2	1	NA	SB	Y
BWP (563)	CW	AV	2	1	PL	<1	2	1	NA	SB	Y

Schedule Notes:
Location: Well Field (WF); East RW Meter Vault (ERMV); West Aerator Building (WAB); Finished Water Entrance Vault (FWEV); High Service Pump (HSP); Backwash Pump (BWP - Washwater)
Service: WW – wastewater; CW – clean water; NPW – nonpotable (raw) water.
Type: AR – air release; AV – air/vacuum; CV – combination air valve.
Installation: PL – indoor; VA – in-vault; OD – outdoor.
Outlet Orifice Size: for air release and combination valves; NA – not applicable.
Body Type: for combination air valves; SB – single body; DB – dual body; NA – not applicable.

B. **Ball Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Ends	Pressure Rating (psi)	Quantity	Operator	Accessories
WF#1 (103)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#2 (113)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#3 (123)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#4 (133)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#5 (143)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#6 (153)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#7 (163)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#8 (174)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#9 (184)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
WF#10 (194)	DRAIN VALVE	BR	1	SKT	250	1	LV	NA
FWMV (220)	ISOLATION VALVE	FP	24	FLG	350	1	HW	NA
PG14 (410)	DRAIN VALVE	BR	2	SKT	250	1	LV	NA

Schedule Notes:
Location: Well Field (WF); Finished Water Entrance Vault (FWEV); Pipe Gallery 1-4 (PG14)
Type: PVC – PVC Body; SS – Stainless Steel Body; VP – V-Port, Metal Seat; BR – Bronze; FP -Full Port
Ends: FLG – flanged; GR – grooved; THR – threaded; SKT – socket; TU – true union.
Operator: HW – hand wheel; CW – chain wheel; PAE – power-activated electric; ON – operating nut; LV – lever.
Accessories: ES – extension stem with stem guides; VB – valve box; FB – floor box; FS – floor stand; FM – furnished by equipment manufacturer

C. **Butterfly Valve Schedule**

Location	Pipe/Use	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
WF#1 (105)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#2 (115)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#3 (125)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#4 (135)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#5 (145)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#6 (155)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#7 (165)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#8 (176)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#9 (186)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#10 (196)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
RWCB (201)	ISOLATION VALVE	30	MJ	4	MN	NA	ES/VB	BU	Y	OC	NPW
RWCA (204)	ISOLATION VALVE	30	MJ	2	MN	NA	ES/VB	BU	Y	OC	NPW
RWCA (205)	ISOLATION VALVE	36	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
ERMV (207)	ISOLATION VALVE	30	MJ	2	MN	NA	ES/VB	BU	Y	OC	NPW
ERMV (209)	FLOW CTRL VALVE (FCV800)	24	FLG	1	EM	DG	N	V	Y	MOD	NPW
WAB (210)	ISOLATION VALVE	24	FLG *	2	MN	NA	ES/VB	BU	Y	OC	NPW
EAB (211)	ISOLATION VALVE	20	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
EAB (212)	ISOLATION VALVE	24	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW

Location	Pipe/Use	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
WWR (213)	ISOLATION VALVE	20	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
FWSV (215)	ISOLATION VALVE	12	FLG	1	MN	NA	ES/FB	V	Y	OC	CW
WAB (302)	FLOW CTRL VALVE (FCV900)	30	FLG	1	EM	DG	N	AG	Y	MOD	NPW
WAB (304)	RAW WATER BYPASS	30	FLG	1	MH	NA	N	AG	Y	OC	NPW
WAB (305)	ISOLATION VALVE	20	FLG	2	MH	NA	EB/FS	SM	Y	OC	NPW
PG56 (404)	FTW FLOW CTRL VALVE (FCV531)	6	FLG	1	EM	DG	N	AG	Y	MOD	WW
PG14 (405)	BACKWASH ROF FCV (FCV 422)	20	FLG	1	EM	DG	N	AG	Y	MOD	NPW
PG14 (406)	MAKEUP WATER ISOLATION	20	FLG	1	EM	DG	N	AG	Y	OC	NPW
PG14 (407)	FILTER INF BYPASS CV	24	FLG	1	EM	DG	N	AG	Y	OC	NPW
PG56 (408)	EAST AERATOR ISOLATION	30	FLG	1	MH	NA	EB	SM	Y	OC	NPW
PG14 (409)	WEST AERATOR ISOLATION	36	FLG	1	MC	N/A	N	AG	Y	OC	NPW
F#1 (411)	FILTER INF CTRL VALVE (CV101)	30	FLG	1	EM	DG	N	AG	Y	OC	NPW
F#1 (412)	FILTER EFF FCV (FCV105A/B)	10	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#1 (413)	FILTER BACK-WASH CV (CV103A/B)	18	FLG	2	EM	DG	N	AG	Y	OC	NPW

Location	Pipe/Use	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
F#1 (414)	WASHWATER DRAIN CV	18	FLG	1	EM	DG	N	AG	Y	OC	WW
F#1 (415)	FILTER TO WASTE CV (CV104A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	WW
F#1 (416)	AIR WASH CV (CV102A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	A
F#2 (421)	FILTER INF CTRL VALVE (CV201)	24	FLG	1	EM	DG	N	AG	Y	OC	NPW
F#2 (422)	FILTER EFF FCV (FCV205A/B)	10	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#2 (423)	FILTER BACK-WASH CV (CV203A/B)	18	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#2 (424)	WASHWATER DRAIN CV	18	FLG	1	EM	DG	N	AG	Y	OC	WW
F#2 (425)	FILTER TO WASTE CV (CV204A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	WW
F#2 (426)	AIR WASH CV (CV202A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	A
F#3 (431)	FILTER INF CTRL VALVE (CV301)	24	FLG	1	EM	DG	N	AG	Y	OC	NPW
F#3 (432)	FILTER EFF FCV (FCV305A/B)	10	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#3 (433)	FILTER BACK-WASH CV (CV303A/B)	18	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#3 (434)	WASHWATER DRAIN CV	18	FLG	1	EM	DG	N	AG	Y	OC	WW
F#3 (435)	FILTER TO WASTE CV (CV304A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	WW

Location	Pipe/Use	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
F#3 (436)	AIR WASH CV (CV302A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	A
F#4 (441)	FILTER INF CTRL VALVE (CV401)	24	FLG	1	EM	DG	N	AG	Y	OC	NPW
F#4 (442)	FILTER EFF FCV (FCV405A/B)	10	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#4 (443)	FILTER BACK-WASH CV (CV403A/B)	18	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#4 (444)	WASHWATER DRAIN CV	18	FLG	1	EM	DG	N	AG	Y	OC	WW
F#4 (445)	FILTER TO WASTE CV (CV404A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	WW
F#4 (446)	AIR WASH CV (CV402A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	A
F#5 (451)	FILTER INF CTRL VALVE (CV501)	24	FLG	1	EM	DG	N	AG	Y	OC	NPW
F#5 (452)	FILTER EFF FCV (FCV505A/B)	10	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#5 (453)	FILTER BACK-WASH CV (CV303A/B)	18	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#5 (454)	WASHWATER DRAIN CV	18	FLG	1	EM	DG	N	AG	Y	OC	WW
F#5 (455)	FILTER TO WASTE CV (CV504A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	WW
F#5 (456)	AIR WASH CV (CV502A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	A
F#6 (461)	FILTER INF CTRL VALVE	24	FLG	1	EM	DG	N	AG	Y	OC	NPW

Location	Pipe/Use	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
	(CV601)										
F#6 (462)	FILTER EFF FCV (FCV605A/B)	10	FLG	2	EM	DG	N	AG	Y	OC	NPW
F#6 (463)	FILTER BACK-WASH CV (CV603A/B)	18	FLG FLG	2	EM	DG	N	AG	Y	OC	NPW
F#6 (464)	WASHWATER DRAIN CV	18	FLG	1	EM	DG	N	AG	Y	OC	WW
F#6 (465)	FILTER TO WASTE CV (CV604A/B/C)	6	FLG	3	EM	DG	N	AG	Y	OC	WW
F#6 (466)	AIR WASH CV (CV602A/B)	6	FLG	2	EM	DG	N	AG	Y	OC	A
ASB (474)	CONTROL VALVE (CV474A/B)	8	FLG	2	EM	DG	N	AG	Y	OC	A
ASB (475)	BLOWOFF BYPASS (CV128)	8	FLG	1	EM	DG	N	AG	Y	OC	A
CW (480)	CONTROL VALVE	30	MJ	2	MH	DG	EB/FS	SM	Y	OC	CW
CW (481)	CONTROL VALVE	36	FLG	3	EM	DG	EB/FS	SM	Y	OC	CW
BWP (502)	ISOLATION VALVE	18	FLG	1	MH	NA	N	AG	Y	OC	CW
BWP (503)	FLOW CTRL VALVE (FCV768)	18	FLG	1	EM	DG	N	AG	Y	MOD	CW
HSP1 (512)	ISOLATION VALVE	16	FLG	1	MH	NA	N	AG	Y	OC	CW
HSP2 (522)	ISOLATION VALVE	12	FLG	1	MH	NA	N	AG	Y	OC	CW
HSP3 (532)	ISOLATION VALVE	16	FLG	1	MH	NA	N	AG	Y	OC	CW
HSP4 (542)	ISOLATION VALVE	16	FLG	1	MH	NA	N	AG	Y	OC	CW

Location	Pipe/Use	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
HSP5 (552)	ISOLATION VALVE	16	FLG	1	MH	NA	N	AG	Y	OC	CW

*Field verify existing end conditions and replace in kind

Schedule Notes:
Location: Well Field (WF); Raw Water Connection B (RWCB); Raw Water Connection A (RWCA); West RW Meter Vault (WRMV); East RW Meter Vault (ERMV); West Aerator Building (WAB); East Aerator Building (EAB); Washwater Reservoir (WWR); Finished Water Meter Vault (FWMV); Clearwell (CW); Pipe Gallery 5/6 (PG56); Pipe Gallery 1-4 (PG14); Filter (F); Air Scour Blower (ASB); Backwash Pump (BWP); High Service Pump (HSP); WTP Finished Water Surge Vault (FWSV); Wellfield Raw Water Surge Vault (RWSV)
Ends: FLG – flanged; GR – grooved; MJ – mechanical joint.
Operator: MH – manual handwheel; MC – manual chainwheel; MN – manual nut; EM –electric motor; LV – Lever actuated with 10 lockable positions; MCR – manual crank
Controls: DG – digital; AG – analog; CC – contact closure; NA – not applicable.
Accessories: FS – floor stands; ES – extension stems; EB – extended bonnets; FB – floor boxes; VB – valve boxes; N – none.
Installation: BU – buried; AG – above ground; SM – submerged; V – underground vault.
Operation: OC – open/closed; MOD – modulating.
Service: WW – wastewater; CW – clean water; A – air, HT – high temperature, NPW – non-potable (raw) water; FM – furnished by equipment Manufacturer

D. **Check Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Ends	Service	Quantity	Mounting	Position Indicator Required	Assist Type	Install	Remarks
WF#1 (104)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#2 (114)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#3 (124)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#4 (134)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#5 (144)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#6 (154)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#7 (164)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#8 (175)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#9 (185)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
WF#10 (195)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	AG	FIBA
FWSV (219)	PREVENT BACKFLOW	RF	12	FLG	NPW	1	H	Y	N	V	FIBA
PG56 (403)	FTW PREVENT BACKFLOW	RF	6	FLG	WW	1	H	Y	N	AG	FIBA
ASB (471)	PREVENT BACKFLOW	NSW	8	FF	AIR	2	H	N	N	AG	FM
ASB (476)	PREVENT BACKFLOW	NSW	8	FF	AIR	2	H	N	N	AG	NA
ASB (477)	PREVENT BACKFLOW	NSW	3	FF	AIR	2	V	N	N	AG	FM
BWP (501)	PREVENT BACKFLOW	RF	18	FLG	CW	1	H	Y	N	AG	FIBA

Location	Pipe/Use	Type	Size (Inches)	Ends	Service	Quantity	Mounting	Position Indicator Required	Assist Type	Install	Remarks
HSP1 (511)	PREVENT BACKFLOW (FCV716)	BC	16	FLG	CW	1	H	Y	HY	AG	NA
HSP2 (521)	PREVENT BACKFLOW (FCV726)	BC	12	FLG	CW	1	H	Y	HY	AG	NA
HSP3 (531)	PREVENT BACKFLOW (FCV736)	BC	16	FLG	CW	1	H	Y	HY	AG	NA
HSP4 (541)	PREVENT BACKFLOW (FCV746)	BC	16	FLG	CW	1	H	Y	HY	AG	NA
HSP5 (551)	PREVENT BACKFLOW (FCV756)	BC	16	FLG	CW	1	H	Y	HY	AG	NA

Schedule Notes:
Location: Well Field (WF); WTP Finished Water Surge Vault (FWSV); Pipe Gallery 5/6 (PG56); Air Scour Blower (ASB); Backwash Pump (BWP); High Service Pump (HSP)
Type: RF – rubber flapper; SC – swing check; BC – ball check; GS – globe style silent check; DD – double door; NSW – non-slam wafer; TD – Tilting Disc
Ends: FLG – flanged; GR – grooved; MJ – mechanical joint; TR – threaded; TU – true union; SK – socket; FF – face to face; ST-Sleeve Type.
Service: WW – wastewater; CW – clean water; NPW – Nonpotable (raw); AIR - air
Mounting: V – vertical; H – horizontal.
Assist Type: for swing check valves only; W – weight and lever; S – spring and lever; HY – hydraulic, N – none.
Install: BU – buried; AG – aboveground; SM – submerged; V – underground vault.
Remarks: FIBA – factory install a backflow actuator; FM – furnished by equipment manufacturer; SB – Short Body

E. **Gate Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Ends	Quantity	Operator	Controls Mounted Remotely	Accessories	Installation	NSF 61 Compliant?	Operation	Service
WF#1 (102)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#1 (106)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#1 (107)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#1 (108)	BLOW OFF VALVE	RW	12	MJ	2	MN	NA	N	BU	Y	OC	NPW
WF#2 (112)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#2 (116)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#2 (117)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#3 (122)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#3 (126)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#3 (127)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#4 (132)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#4 (136)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#4 (137)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#4 (138)	ISOLATION VALVE	RW	24	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#5 (142)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#5 (146)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#5 (147)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW

Location	Pipe/Use	Type	Size (Inches)	Ends	Quantity	Operator	Controls Mounted Remotely	Accessories	Installation	NSF 61 Compliant?	Operation	Service
WF#6 (152)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#6 (156)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#6 (157)	ISOLATION VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	NPW
WF#7 (162)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#8 (172)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#8 (173)	BLOW OFF VALVE	RW	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#9 (182)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#9 (183)	BLOW OFF VALVE	RW	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#10 (192)	BLOW OFF VALVE	RW	8	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#10 (193)	BLOW OFF VALVE	RW	12	FLG	1	MH	NA	N	AG	Y	OC	NPW
WF#1 (197)	BLOW OFF VALVE	RW	12	MJ	1	MN	NA	N	BU	Y	OC	NPW
BDB (203)	BLOW OFF VALVE	RW	8	FLG *	1	MN	NA	ES/VB	BU	Y	OC	NPW
FWM (221)	ISOLATION VALVE (EX)	RW	16	MJ	1	EX	NA	EX	BU	Y	OC	CW
FWM (222)	TAPPING VALVE	RW	16	MJ	1	MN	NA	ES/VB	BU	Y	OC	CW
FWM (223)	ISOLATION VALVE	RW	4	MJ	3	MN	NA	ES/IP	BU	Y	OC	CW
RWSV (224)	ISOLATION VALVE	RW	12	FLG	1	MN	NA	ES/FB	V	Y	OC	NPW
WAB (307)	O/FLOW FLAP GATE	PR	6	FLG	2	NA	NA	NA	SM	Y	NA	NPW (SS)
EAB (309)	O/FLOW FLAP GATE	PR	6	FLG	1	NA	NA	NA	SM	Y	NA	NPW (SS)

Location	Pipe/Use	Type	Size (Inches)	Ends	Quantity	Operator	Controls Mounted Remotely	Accessories	Installation	NSF 61 Compliant?	Operation	Service
PG56 (402)	FTW PUMP SUCTION	RW	6	FLG	1	MH	NA	N	AG	Y	OC	WW
CW (482)	O/FLOW FLAP GATE	PR	12	FLG	4	NA	NA	NA	SM	Y	NA	CW (SS)
FAPW (505)	ISOLATION VALVE	RW	4	FLG	6	MH	NA	N	AG	Y	OC	CW

Schedule Notes:
Location: Well Field (WF); Aerator Building (EAB); Pipe Gallery 5/6 (PG56); Filter Annex Plant Water (FAPW); Clearwell (CW); Blow Off/Drain Box (BDB)
Body Type: RW – resilient wedge gate valve; BB - bronze body; PR – pressure relief (flap)
Ends: FLG – flanged; GR – grooved; MJ – mechanical joint.
Operator: MH – manual handwheel; MC – manual chainwheel; MN – manual nut; EM –electric motor; MCR – manual crank
Controls Mounted Remotely: for PAE operators only; Yes – Remote mounted LCD control panel as shown on the plans; No – integral LCD control panel; NA – not applicable.
Accessories: FS – floor stands; ES – extension stems; EB – extended bonnets; FB – floor boxes; VB – valve boxes; N – none; IP – Indicator Post.
Installation: BU – buried; AG – above ground; SM – submerged; V – Vault.
Operation: OC – open/closed; MOD – modulating.
Service: WW – wastewater; CW – clean water; NPW – nonpotable (raw) water.

F. **Knife Gate Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Quantity	Operator	Accessories

Schedule Notes
Location:
Type: B – bonneted; BL - bonnetless
Operator: HW – handwheel; CW – chainwheel; CY – cylinder; EM – electric motor
Accessories: BG – Bevel gear actuator

G. **Mud Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Quantity	Operator	Accessories

Schedule Notes
Location:
Type: SS – Stainless Steel Mud Valve; CI – Cast Iron Mud Valve.
Operator: HW – handwheel; ON – operating nut.
Accessories: ES – extension stem with stem guides; FS – floor stand; FB – floor box.

H. **Plug Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
WAB (306)	DRAIN VALVE	FP	10	FLG	2	MH	NA	FS/EB	SM	Y	OC	NPW
EAB (308)	DRAIN VALVE	FP	10	FLG	1	MH	NA	FS/EB	SM	Y	OC	NPW
PG14 (401)	DRAIN VALVE	FP	6	FLG	1	MH	NA	N	AG	Y	OC	NPW

Schedule Notes:
Location: West Aerator Building (WAB); East Aerator Building (EAB); Pipe Gallery 1-4 (PG14)
Type: FP – full port; RP – reduced port.
Ends: FLG – flanged; GR – grooved; MJ – mechanical joint.
Operator: MH – manual handwheel; MC – manual chainwheel; MN – manual nut; PAE – power-actuated electric; MCR –manual crank
Controls: DG – digital; AG – analog; CC – contact closure; NA – not applicable.
Accessories: FS – floor stands; ES – extension stems; EB – extended bonnets; FB – floor boxes; VB – valve boxes; N – none
Installation: BU – buried; AG – above ground; SM – submerged; V – underground vault.
Operation: OC – open/closed; MOD – modulating.
Service: WW – wastewater; CW – clean water; NPW – non-potable (raw) water

I. **Control Valve Schedule**

Location	Pipe/Use	Body Type	Size (Inches)	Ends	Quantity	High Pressure Setting (psi)	Low Pressure Setting (psi)	Flow Setting (gpm)	Function	NSF 61 Compliant?	Service
RWSV (202)	CONTROL VALVE	G	12	FLG	1	105	20	50-7000	SA	Y	NPW
FWSV (216)	CONTROL VALVE	G	12	FLG	1	200	20	50-7000	SA	Y	CW
ASB (473)	PRESSURE RELIEF	G	4	FLG	2	FM	FM	FM	PRF	Y	A
FAPW (507)	PRESSURE REDUCING	G	4	FLG	1	80	40	4-800	PRV	Y	CW
FAPW (508)	PRESSURE REDUCING	G	4	FLG	1	150	15	4-800	PRV	Y	CW

Schedule Notes:
Location: WTP Finished Water Surge Vault (FWSV); Air Scour Blower (ASB); Filter Annex Plant Water (FAPW); Wellfield Raw Water Surge Vault (RWSV); Pipe Gallery 5-6 (PG56)
Body Type: A – angle pattern; G – globe "Y" pattern.
Ends: FLG – flanged; GR – grooved; TH - Threaded.
Function: PRF – pressure relief; PRV – pressure reducing; PC – pump control; OA – one way altitude; TA – two way altitude; SA – surge anticipator; FC – flow control;
Service: CW – clean water; NPW – nonpotable (raw) water; A – air.

J. **Telescoping Valve Schedule**

Location	Description	Size (in)	Quantity	Operating Floor Elevation	High Weir Elevation	Low Weir Elevation	Travel (ft)	Baffle	Stem	Actuator	Actuator Mounting	Controls

Schedule Notes:
Location:
Stem: NR – nonrising; R – rising.
Actuator: MHW – manual handwheel; MCR – manual cranked; PAE – power-actuated electric, Nut – Manual Operating Nut.
Actuator Mounting: OFS – offset floor stand; SFS– straight floor stand; BS – benchstand or yoke-mounted; TWB – top-of-wall bracket; FB – floor box.
Controls: DG – digital; AG – analog; CC – contact closure; NA – not applicable.

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SECTION 40 05 25.03

STAINLESS STEEL STOPLOGS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including Division 1 Specification Sections apply to this Section.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the stoplogs and accessories.

1.3 **QUALITY ASSURANCE**

A. **Codes and Regulatory Agencies**. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards as referenced herein:

1. ASTM – American Society for Testing and Materials.
2. The stoplog Manufacturer shall be ISO 9001 Certified.
3. Welds shall be performed by welders with ASME Section IX or AWS D1.6 certification.

1.4 **SUBMITTALS**

A. **Shop Drawings and Product Data**. Submit shop drawings and product data for the stoplogs for review. Shop drawings shall be specific to the project. Catalog cuts and general arrangement drawings are not acceptable for shop drawings. Shop drawings shall be in accordance with Section 01 33 00, Submittals, and shall include:

1. Manufacturer's name.
2. Log and lifter materials.
3. Dimensions.
4. Connection details.
5. Parts list with materials and part numbers for the stoplogs and accessories.
6. Design calculations and supporting data for all logs showing stresses, loads, and deflection for critical parts under design head conditions.
7. Manufacturer's instructions.
8. ISO certification.

1.5 **JOB CONDITIONS**

A. **Stoplog** grooves and stop logs shall be suitable for installation in outdoor conditions.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. Deliver, store, and handle the stoplogs and accessories in accordance with the manufacturer's instructions.

B. **Storage**. Store logs under cover and out of direct contact with the ground.

C. **Handling**. Handle logs to avoid damage. Logs which are cracked, dented, dropped, or otherwise damaged will not be accepted.

1.7 **SPECIAL WARRANTY**

(Not Used)

PART 2 - PRODUCTS

2.1 **DESIGN CRITERIA**

A. **Design**

1. Stoplogs shall not float without any allowance for for interlocking of adjacent stop logs.
2. Stoplogs shall lower into place through gravity.

B. **Deflection.** Maximum allowable deflection shall be less than 1/360 of the span or 1/4 inch, whichever is less, under the design load in the gate schedule.

C. **Lifting Device.** A stainless steel lifting device shall be provided to install and remove the stop logs from the frame. The lifting device shall automatically engage each stop log individually for installation or removal from the operating deck.

D. **Leakage**. Maximum allowable leakage of stoplogs with seating head shall not exceed 0.05 gallons per minute/feet (gpm/ft) of wetted perimeter.

2.2 **MATERIALS AND CONSTRUCTION**

A. **Stoplog Materials**. Stoplogs shall be manufactured of Type 304 or Type 304L stainless steel per ASTM A240.

1. All welded stainless steel components shall be constructed of type 304L stainless steel.
2. All structural stainless steel used in the construction of stop logs, frames and storage racks (if applicable) shall have a minimum material thickness of ¼-inch.
3. All non-welded stainless steel components, excluding anchor bolts and assembly bolts shall be Type 304 stainless steel.

B. **Stoplog Construction**. The stop logs shall be constructed of formed plate reinforced with stiffeners, as needed to withstand the specified head conditions. The log shall engage the frame a minimum of 4 inches on each side.

1. The stop log shall be reinforced with plates or channel shaped members to restrict deflection to the maximum allowable deflection at the design head.
2. Stoplogs shall be identical and designed to stack in any sequence.
3. Each stoplog shall include a stainless steel identification tag, attached via welding, designating the manufacturer's name, opening width, and maximum head rating.

C. **Frame**. New Guide frames shall be manufactured of Type 304 or 304L stainless steel.

1. The frame shall be a rigid, one-piece assembly as configured on the Contract Drawings.
2. Frames can be provided in three sections, with bolted corner sections, when shipping restrictions prevent shipping a frame intact. A brace, for shipping and installation, shall be provided across the top of the frame when recommended by the manufacturer.
3. Wall mounted frames shall be reinforced with gussets to minimize frame deflection in the unseating head condition.

D. **Anchor Bolts**. All anchor bolts and assembly bolts shall be Type 316 stainless steel.

1. Anchor bolts shall be fully threaded.
2. Anchor bolts shall have a minimum diameter of ½ inch.
3. Anchor bolts shall be epoxy type.

E. **Seals**. The seal system shall consist of a set of resilient lip seals along the sides and across the bottom of each log.

1. All seals shall be mounted on the stop logs.
2. Seals shall be extruded Neoprene, EPDM or urethane conforming to ASTM D2000, grade 2BC515, durometer 50+-5. Bottom seals shall conform to ASTM D2000, grade AA625.
3. Provide UHMWPE wear bar on the side of the stop opposite the seal.
4. The seals shall be secured with 316 SS assembly bolts and 304 stainless mounting bars/flanges. All seals shall be field removable and replaceable.

F. **Lifting Device**

1. The portion of the lifting device that engages the frame shall be outfitted with UHMWPE bearing strips to ensure no metal-to-metal contact occurs between the lifting device and the inside of the frame.
2. The lifting device shall be provided with a lifting lug on the top and utilized in conjunction with a hoist or crane.

G. **Finish.**

1. All heat tint and slag from the welding process shall be passivated or mechanically passivated through bead blasting in accordance with ASTM A380.

2. Grinding or buffing is not acceptable in lieu of passivation.

H. **Manufacturers.** Subject to compliance with the specifications, provide the gates from the following approved manufacturers:

1. RW Gate Company
2. Alternative Bid Equipment: Whipps, Waterman LLC

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Inspection**

1. Verify job conditions, actual opening dimensions of existing structures, and intended stoplog service before ordering.
2. Inspect for damage to stoplogs resulting from shipping and handling prior to installation.

3.2 PREPARATION

A. **Handling**

1. Handle stoplogs and accessories with care.
2. Comply with the manufacturer's instructions.

3.3 INSTALLATION

A. **Procedures**

1. Install in accordance with manufacturer's instructions.
2. Install plumb and level.
3. Install free from distortion.
4. Non-shrink grout shall be applied between the frame and the wall to ensure that there is no leakage around the frame.

3.4 FIELD QUALITY CONTROL

A. **Inspection**

1. Verify conformance with manufacturer's shop drawings and instructions.
2. Report defects in workmanship, materials, and performance.

3.5 ADJUSTING

A. **Procedures**

1. Follow manufacturer's instructions.

3.6 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for start-up and test services, and operation and maintenance personnel training services:

1. Instruction To City Personnel: Provide 0.5-hour training session, on two separate events, for Owner training of system.
2. Additional Support: Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. Representative shall respond to requests for revisits within 5 working days of request.

B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

3.7 DEMONSTRATION

A. General

1. Demonstrate proper operation under actual service conditions for minimum of 8 hours to demonstrate specified maximum leakage.
2. Demonstrate operation of lifting device for all log positions.
3. Repair or replace any defective parts at no cost to the Owner.

3.8 STORAGE

A. Contractor shall fabricate and provide one self supporting storage rack per log size in schedule with brackets and supporting chains and necessary hardware for storage of the planks above ground.

3.9 MAINTENANCE

A. Contractor's Responsibility

1. Conform to manufacturer's recommended procedures.
2. Provide initial lubrication and maintenance.
3. Perform maintenance until the installation is accepted by the Owner.

PART 4 - STOPLOG SCHEDULE

4.1 **GENERAL**. The Stoplog Schedule is for the convenience of the Contractor and the omission of any stoplogs does not release the Contractor from the responsibility to furnish and install all the stoplogs required by the drawings.

A. **Stoplog Schedule**

Location	Channel Width	Total Height of Stop Logs	Design Head	Remarks/Comments
Filter Influent Flume	3’-10 3/8”	3’-6”	4’-0”	Stop Logs to be placed at two (2) different locations as shown on Contract Drawings

END OF SECTION

SECTION 40 42 13

PROCESS PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Process Piping**. See Section 40 05 13, "Process Piping," and Section 40 05 18, "Process Piping, Accessories."

C. **Painting**. Painting is specified in Section 09 90 00, “Painting”.

D. **Submittals**. See Section 01 33 00, "Submittals."

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to furnish and install the process piping insulation.

1.3 QUALITY ASSURANCE

A. **Codes**. Perform all work to furnish and install the process piping insulation in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. **Standards**

1. ASTM – American Society for Testing and Materials.

1.4 SUBMITTALS

A. **Approval Drawings**. Submit shop drawings and product data for approval. Shop drawings shall be in accordance with Section 01 33 00, “Submittals” and shall include:

1. Manufacturer's name.
2. Product data including insulation and jacketing material, thickness, manufacturer's product number, K-value, and all furnished accessories.
3. Dimensional layouts and locations.
4. Complete description in sufficient detail to permit an item-by-item comparison with the specifications.
5. Manufacturer's instructions.

1.5 **JOB CONDITIONS**

A. **General**. Verify job conditions which may impact insulation layouts and dimensions prior to ordering materials. Install insulation to field measurements unless specifically noted otherwise.

B. **Coordination**. Coordinate with all other trades to prevent delays, errors, or omissions.

C. **Climatic Conditions**. Do not perform installation when ambient conditions would cause damage to the materials, jacketing, or otherwise violate manufacturer's installation requirements.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. Deliver, store, and handle the process piping insulation in accordance with Section 01 60 00, “Materials and Equipment” and the manufacturer's instructions.

B. **Containers**. Insulation, covering, cements, adhesives, and coatings shall be delivered to the site in containers with manufacturer's stamp or label showing fire hazard index of products.

C. **Protection**. Protect insulation against dirt, water, and chemical and mechanical damage. Remove wet or damaged insulation from project site.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Foam Piping Insulation**

1. Foam Insulation. Flexible, unicellular, foamed insulation with sealed end joints. ASTM C 534, Type 1.
2. Insulation shall be coated in accordance with Section 09 90 00, "Painting."
3. Insulation shall be Johns-Manville Aerotube; Rubatex; Armstrong Armaflex; or equal.

B. **Fiberglass Piping Insulation**

1. Fiberglass insulation shall be in accordance with ASTM C 547, Class 1 for use up to 450 degrees Fahrenheit (°F).
2. The minimum insulation thickness shall be the minimum required for condensation control, but in no case less than the following minimum thickness with factory applied vapor barrier and all joints firmly butted, lapped, and sealed with vapor barrier cement:
   a. ¾ inch thick for pipes under 1” diameter,
   b. 1 inch thick for pipes up to 12” diameter,
   c. 2 inch thick for pipes larger than 12 inches.

3. Exterior insulation shall be three (3) inches thick with aluminum jacketing. Jacketing shall beet ASTM C 921, Type I (vapor barrier) including all the typical requirements in Table 1 in the reference standard. The aluminum shall meet ASTM B 209.
4. Insulation shall be Johns-Manville Micro-Lok, Owens Corning, or equal.

C. **Equipment Insulation**

1. Flexible Fiberglass Equipment Insulation. ASTM C 553, Type I, Class B-6 (3 pounds per cubic foot density). Insulation shall be Manville Products Corp., Owens-Corning Fiberglas Corp., or equal.

D. **Accessories**

1. Insulation installed outside shall be coated or jacketed as recommended by the manufacturer for a weatherproof installation.
2. Staples, Bands, Wires, and Cement. As recommended by insulation manufacturer for applications indicated.
3. Adhesives, Sealers, and Protective Finishes. As recommended by insulation manufacturer for applications indicated.

E. Field Applied Jackets

1. PVC: Indoor/Outdoor, UV-resistant fittings, jacketing and accessories white or colored. Fitting cover system consist of pre-molded, high impact PVC materials with fiberglass inserts. Closures: stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.
2. Metal: Aluminum, 0.0016" (0.406 mm) thick or Stainless Steel, 0.0010" (0.254 mm) thick in smooth, corrugated, or embossed finish with factory applied moisture barrier. Overlap shall be 2" (50 mm) minimum. Fittings shall be die-shaped with factory applied moisture barrier.
3. Laminated Self Adhesive Water and Weather Seals: permanent acrylic self-adhesive system; weather resistant, high puncture and tear resistance; meeting or exceeding requirements of UL 723; applied in strict accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSPECTION

A. **Existing Conditions**. Examine areas and conditions under which insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.

B. **Insulation**. Inspect insulation for dirt, water, or damage. Do not install wet or damaged insulation.

3.2 INSTALLATION

A. **Insulation Omitted**. Omit insulation on unions, check valves, balance cocks, and flow regulators.

B. **General Piping**. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

1. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
2. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
4. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
5. Cover valves, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut, or job fabricated units (at installer's option) except where specific form or type is indicated.
6. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.
7. Hangers. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3 inches wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3 inches wide vapor barrier tape or band.
8. Copper Pipe. Insulation used in below grade and outdoor installations shall be free from nitrites and not contain more than 0.2 percent ammonia.
9. Outdoor Insulation. Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by the manufacturer.

C. **Insulation Joints**. Install insulation with all end joints with an adhesive as recommended by the manufacturer. Apply insulation without longitudinal joints by slipping the insulation over the lengths of pipe before connections are made. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

D. **Equipment Insulation**

1. General. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
2. Surfaces. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

3. Vapor Barrier. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.
4. Temperature. Do not apply insulation to equipment, breechings, or stacks while hot.
5. Joints. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
6. Cement. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
7. Jacket. Cover insulated surfaces with all service jacketing neatly fitted and firmly secured. Lap seams at least 2 inches. Apply over vapor barrier where applicable.
    a. Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.
8. Removable Insulation. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
9. Equipment Exposed to Weather. Protect outdoor insulation from weather by installation of weather barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

3.3 EXISTING INSULATION

A. **Protection**. Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period to avoid damage and deterioration.

B. **Repair**. Repair damaged sections of existing insulation, either previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation; install new jacket lapping and seal over existing.

C. **Replacement**. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

3.4 INSULATED PIPING LIST

A. **General**. The following exposed process piping of the size shown on the plans shall be insulated.

1. Foam with Interior/Exterior PVC Jacket:
    a. Exposed Raw Water Forcemain inside Well and Aerator Buildings
    b. Filter Effluent
    c. Exposed Finished Water Discharge Piping

d. Backwash Supply and Lines
e. Filter-to-Waste Discharge Piping
f. Plant Water and Surface Wash (4” and Larger)
g. Storm drains in heated process rooms up to vertical drop (excludes Aerator Buildings)

2. Fiberglass Insulation with Interior/Exterior PVC Jacket
   a. Plant Water and Surface Water under 4-inch
3. Exposed raw, process, and finished water piping located within vaults do not require insulation.

END OF SECTION

SECTION 40 90 00

INSTRUMENTATION SYSTEMS BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. The following sections contain requirements that relate to this section:

1. Section 22 05 53, "Plumbing Identification."
2. Section 26 00 01, "Basic Electrical Requirements."
3. Section 26 00 02, "Basic Electrical Materials and Methods."
4. Section 26 05 33, "Raceways."
5. Section 26 05 12, "Wires, Cables, and Connectors."
6. Section 26 05 23, "Communication and Signal Cables."
7. Section 26 05 34, "Cabinets, Boxes and Fittings."
8. Section 26 27 26, "Wiring Devices."
9. Section 26 05 29, "Supporting Devices."
10. Section 26 05 53, "Electrical Identification."
11. Section 26 05 26, "Grounding."
12. Section 40 93 13, "Control Devices."

1.2 DESCRIPTION OF WORK

A. **Scope of Work.** The Electrical Contractor shall provide the labor, tools, equipment, and materials necessary to implement general administrative and procedural requirements for instrumentation installations in accordance with the plans and as specified. The following administrative and procedural requirements are included in this section to expand the requirements specified in Division 1:

1. Quality assurance.
2. Submittals.
3. Job conditions.
4. Delivery, storage, and handling.
5. Special warranty.
6. Definitions.

B. **Work under this contract** consists of furnishing, installing, testing, and guarantee of the complete instrumentation system as shown on the drawings and as specified herein. The Contractor shall connect and place all equipment in proper working order. The following is a general summary of work comprising the instrumentation system and is hereby included:

1. Instrumentation equipment specified in Division 40.

2. Branch circuit conduit and wiring to all instrumentation equipment. 120 volt 1 phase circuit breakers are provided for instrument use at designated panelboards as work of Division 26. Work of this section begins with branch circuit connection to these circuit breakers and includes branch circuit wire and conduit.
3. Signal wiring between all instrumentation equipment.
4. Interlock wiring between instrumentation equipment and equipment furnished under other divisions of the specifications. Interlocks shall include alarm contacts, control contacts, and 4-20 ma analog signals. Such interlocks are required by diagrams, schematics, notes, or narrative descriptions. Extend these interlocks to and land them on terminal strips provided in equipment, motor starters, motor control centers, etc.
5. Raceway system interior to structures and exterior within 5 feet of structures for instrumentation wiring. Raceway only shall be provided between buildings as part of Division 26 work. See Electrical Plans for extent of such raceway. Any additional exterior raceway required shall be part of work of this section.
6. The Contractor shall hire an instrumentation and control (I&C) system integrator to participate in performing the I&C work.
7. The responsibilities of the I&C system integrator shall include:

    a. Prepare instrument loop drawings.
    b. Provide and calibrate instruments and controls.
    c. Prepare schematics and layout drawings, and fabricate accordingly.
    d. Configuration and programming.

8. The integrator shall provide operating instruction manuals with adequate information pertaining to the following:

    a. System specifications.
    b. Electrical power requirements.
    c. Application considerations.
    d. Assembly and installation procedures.
    e. Power up procedure.
    f. Troubleshooting procedure.
    g. Programming procedure.
    h. Explanation of internal fault diagnostics.
    i. Shutdown procedures.
    j. Recommended spare parts list.

C. **System Tests**

1. The Contractor shall prepare and submit to the Engineer for review, a detailed description of the test procedures that he proposes to perform to demonstrate performance of the complete system.

2. The Contractor shall provide Instrument Calibration Sheets and a space for sign-off on individual items and list by the Contractor. A sample of an Instrument Calibration Sheet form shall be submitted for approval by the Engineer.

3. Test Plans. Specific test plans shall be written to cover all phases of factory and field testing and shall include, but may not be limited to, the following:

   a. Describe the purpose of the tests, the test equipment required, and the step-by-step method of implementation necessary to accomplish the specified test as well as define the necessary test prerequisites.
   b. Comprise drawings and figures that show the test equipment arrangement and the interconnection of test equipment to the portion of the equipment system under test.
   c. Include associated test data sheets which must be completed with the test data as each test progresses. The test program shall require satisfactory completion of the tests in sequence which shall demonstrate that the design hardware and software procured and installed are effective and safe. As each phase of testing is complete, the test data sheets shall be signed and dated.

1.3 QUALITY ASSURANCE

A. **Codes and Standards.** Perform all work in accordance with the applicable requirements of governing agencies having jurisdiction and in accordance with the plans and as specified herein. Comply with applicable provisions and recommendations of the following:

1. Instrument Society of America (ISA).
2. National Electrical Code (NEC).
3. National Electrical Manufacturers Association (NEMA).
4. Institute of Electrical and Electronic Engineers (IEEE).
5. American National Standards Institute (ANSI).
6. National Fire Protection Association (NFPA).
7. Scientific Apparatus Manufacturers Association (SAMA).
8. Underwriters' Laboratories (UL).
9. Joint Industrial Council (JIC).
10. Factory Mutual (FM).
11. International Standards Organization (ISO).
12. American Society for Testing and Materials (ASTM).
13. International Electrotechnical Commission (IEC).
14. Electronic Industries Association (EIA).

B. **Qualifications**

1. Manufacturer's Qualifications.

    a. A financially sound firm with at least 5 years of experience in design, manufacture, supply, service, and support of instrumentation and control equipment specified for this project.
    b. A record of prompt shipments in accordance with contract obligations.
    c. A documented quality assurance program complying with industry and agency standards.
    d. A documented product safety policy relevant to the products being manufactured for this project.

2. Installer's Qualifications. An approved manufacturer's representative factory educated in maintenance, installation, and start-up of the instrumentation and control equipment to be supplied.

3. System Integrator Qualifications.

    a. A financially sound firm with at least 7 years of experience in design, implementation, supply, training and technical support of instrumentation and control systems for the type of facility covered by these drawings and specifications.
    b. A documented record of success in installation of DCS-Based SCADA process control systems, with a minimum of three successful installations completed within the past 5 years for treatment plants with peak flow capacity greater than 10 MGD.
    c. An engineering and technical staff with knowledge of applicable processes and practices.
    d. A minimum of 5 years of experience in system integration and programming of instrumentation components specified.
    e. A toll free line for 24/7 technical support, with emergency pager number with maximum 4 hour emergency response time to return call, and provide technical assistance and troubleshooting during the start-up or within two (2) years following substantial completion at no cost to the Owner.

C. **System Responsibility**. The instrumentation and control system shall be furnished by one integrator who shall be responsible for the development of submittals, acceptance tests, start-up and support, and all warranty work for the entire system. Responsibility cannot be split among individual suppliers. The system integrator’s responsibility shall include but not limited to:

1. Provide, calibrate, establish data communication and basic field operational start-up of all field instruments.
2. Provide, assemble, install and start-up process control panel (PCP) and all related equipment.
3. Provide, assemble, install and test PLCs, HMI and communication equipment provided by the system integrator.

4. Furnish communication cabling system including Fiber optic, Ethernet and Profibus cables. Perform all field terminations and field testing as required.
5. Provide, perform all necessary hardware, software, programming to interface the PLCs with the other vendor supplied PLCs, devices, equipment and the existing City wide SCADA system over Ethernet, Profibus and hardwired medium as shown on the drawings.
6. Provide, perform all necessary hardware, software, programming to interface the new field instruments, panels, devices.
7. Provide calibration documentation on all calibrated equipment.
8. Provide operational and maintenance manual documentation including I/O allocation, wire and terminal numbers and system components.
9. Development of system and equipment shop drawings, record drawings and O&M manuals for all equipment and systems provided by the system integrator.
10. Operator training as specified herein.
11. Refer to section 40 95 33 for additional system requirements.

D. **System Integrator Coordination**. System integrator to coordinate with the City Programming Consultant (CPC) and all other parties for installation of all items specified herein and required to ensure the complete and proper interfacing of all components and systems.

1.4 SUBMITTALS

A. **Sequencing and Scheduling.** Follow the procedures specified in Division 1 section "Submittals," and in addition, the Contractor shall prepare and submit a complete submittal list to the Engineer/Architect. The submittal list shall include all submittal items covered in the Division 40 specification sections. In addition, the submittal list shall contain dates for all items to be submitted and shall accompany the first submittal. Submittal list date changes shall be updated on a monthly basis. The submittal list shall be coordinated with the construction schedule and shall clearly show such coordination. Include expected dates for gaining approval for each Division 40 specification section. The submittal list shall include the expected factory test, equipment shipping, installation, and operational test dates for each Division 40 specification section.

B. **System Responsibility**. Submit a letter from the responsible integrator stating acceptance of system responsibility.

C. **Shop Drawings**. Submit shop drawings to substantiate that the materials and equipment comply with the specification requirements. All drawings, data sheets, lists, forms, etc., shall clearly state the job name, Owner, location, and date. Submit the following types of drawings in accordance with Section 01 33 00.

1. Materials List. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers listed by equipment tag numbers. All equipment shall have a tag number. The list shall identify sheet numbers where each tag numbered item can be found.

2. Product Data. Submit manufacturers' technical product data sheets for items listed in the instrument schedule and for any additional components required for a complete functional system. Delete or "x" out inappropriate or inapplicable information on each page of product data submittals.
3. Specification Form. A completed specification form similar to ISA Standard S20 shall be included for each instrument. The specification form shall include an instrument tag number as per ISA Standard S5.1 Section 3.1.
4. Dimensional Drawings. Submit dimensional drawings for instrument mounting, process connection details, instrument cabinets, panels, and each piece of equipment.
5. Wiring Diagrams. Submit the following:

    a. Field wiring diagrams for wiring into and out of control panels, identifying terminal numbers of the field equipment or other remote termination points.
    b. Master interconnection wiring and piping drawing showing all field and panel mounted equipment and terminal identifications. Each individual manufacturer's system drawings shall be furnished.
    c. Internal wiring drawings for each control panel identifying each and every component, numbered wire, numbered terminal, and terminal block. Loop diagrams shall follow ISA-S5.4 format.

D. **Operation and Maintenance Manuals**. Submit four bound and indexed operation and maintenance (O&M) manuals prior to delivery of the equipment. Each option and accessory shall be clearly and accurately shown. The O&M manuals shall include:

1. Installation instructions and details.
2. Start-up instructions.
3. O&M instructions.
4. Detailed parts list with name, address, and telephone number of supply source.
5. Troubleshooting guide.
6. Electrical and mechanical diagrams.

E. **Spare Parts List**. Submit a list of spare parts required to be supplied by the Contractor.

1. List. Include a current parts list indicating part name, equipment, name, stored quantity, manufacturer/source address, telephone number, and salespersons name within the secured storage area.

F. **Samples**

1. Nameplate size selection and lettering style.
2. Samples of factory colors for prefinished housings and enclosures.

G. **Software Documentation**. Submit four annotated copies of all software required to be furnished as part of these specifications and four copies of a

written description of the software. Software includes configuration. Submit annotated logic diagrams and graphics formatted as a Microsoft Word document and stored on CDs. If annotated logic diagrams and graphics cannot be formatted as a Microsoft document, provide the required software for use by the consultant for review purposes.

H. **Test Procedures**. Submit to the Engineer/Architect for review, a detailed description of field test procedures proposed to demonstrate performance of the complete system. Whenever possible "live" inputs and functional outputs shall be used. Whenever this is not possible, the Contractor shall simulate inputs and loads.

I. **Contract Closeout Submittals**

1. Project Record Documents. The Contractor shall have two working sets of prints of the Contract Drawings and submittals. The Contractor shall furnish an identical bound set, with index tabs, to the Owner's Representative when field wiring is to begin. All changes made during the course of the work shall be made by the Contractor to the field set and transferred to the office set of prints on a weekly basis. Dated copies clearly showing "As Built" or "As Constructed" information shall be sent weekly for each affected sheet to the Owner's Representative. Both sets shall be available for comparison by the Owner's Representative and Owner during the course of the work. After project completion both sets of documents shall be delivered to the Owner.
2. O&M Manuals. Replace all affected drawings supplied in the O&M manuals with "As Built" revised drawings.
3. O&M Manuals. See section 01 33 00, “Submittals” for additional O&M manual requirements.
4. Record Drawings. The Contractor shall furnish detailed wiring drawings for all instruments and controls. Drawings shall show all tag numbers, point-to-point wiring, and terminal numbers used on the external wires. In addition, any changes made by the Contractor to internal wiring of equipment or components inside enclosures furnished by the Contractor shall have "As Constructed" revisions to the original manufacturer's drawings detailing these additions or revisions. The record drawings shall include all wire numbers and terminals used plus a list of all settings for each instrument. Replace all affected drawings supplied in the O&M manuals with record drawings.
5. Maintenance Service. Offer a yearly maintenance agreement to the Owner listing the terms and conditions of this maintenance service along with a price for the second year of operation.

1.5 JOB CONDITIONS

A. **Protection**. Manufacturer's requirements for protecting equipment from heat, cold, moisture, dust, and rough handling shall be strictly adhered to.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Packing and Shipping**. Deliver equipment properly packaged and mounted on pallets or skids to facilitate handling of heavy items. Utilize factory fabricated type containers or wrappings for components which protect equipment from damage.

B. **Acceptance at Site**. Inspect equipment to ensure that no damage has occurred during shipment. Handle equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which would damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new. Inspect all equipment at time of delivery as to model, quantity, and physical condition. All equipment shall be identified by name and tag number. Site conditions must be clean, dry, heated, and dust free before equipment is removed from packaging or installed.

C. **Storage and Protection**. The Contractor shall store the items furnished under this section until they can be installed. Such storage shall meet the requirements of the system supplier and be approved by the Owner. Use all means necessary to protect the material of this section before, during, and after installation, and to protect the installed work and materials of all other trades. Provide factory applied end caps to protect all threads on pipes and valves.

1.7 SPECIAL WARRANTY

A. **General.** The Contractor shall retain the services of factory trained servicemen to provide repair services for the instrumentation and control system for 1 year, commencing with the time the system equipment is complete and accepted by the Owner, and including all repair and replacement parts needed during the warranty period.

1.8 DEFINITIONS

A. **Manufacturer**. The designer and fabricator of an instrumentation or control product.

B. **System Integrator**. The designer, assembler, and supplier of the complete instrumentation and control system. The system integrator has responsibility to the Contractor and Owner for a complete functional instrumentation and control system.

C. **Interior**. For the purposes of this specification, interior is any area within the boundaries of the foundation, walls, and roof of any building or other structure.

D. **Wet Locations**. Exterior areas, interior areas below grade, and interior areas above grade in which wet materials are processed, pumped, transported, or stored are designated as wet locations. Equipment installed in these areas must bear a manufacturer's certification of suitability for such environments.

1.9 MAINTENANCE

A. **Service Contract**. The system integrator shall prepare and submit an extended warranty or service agreement to maintain the instrumentation system after the 1 year special warranty.

B. **Spare Parts**. The Contractor shall provide an adequate supply of spare parts to the Owner for facilitating proper maintenance and minimizing downtime of the process control system. The spare parts list shall consist of the supplier's recommendations required to maintain the equipment in working order. The spare parts shall be modular plug-in type equipment.

1. Each spare part used during the start-up, demonstration, and warranty period shall be replaced by the Contractor at no cost to the Owner.
2. The Contractor shall submit the list of spare parts to be stored at the plant site including a list of parts available at a local site and parts obtainable from a distance. The Contractor shall list the sources of parts in the spare listing and estimated time required to obtain spare parts. The Contractor shall submit spare part information which includes the manufacturer's name, complete part model number, and the supplier location, telephone number, and price.
3. Spare parts documentation shall include instructions for removal of failed parts and installation of replacement parts. The spare parts list and descriptions shall be submitted for review prior to system installation.

C. **Consumables**. Consumables are items used up or consumed during normal equipment operation. These items shall include paper, ribbons, tapes, ink, toner, cleaner, lubricant, and others described below.

1. The process control system integrator shall submit documented instructions with illustrations for changing used items, such as ribbons, printer paper, chart pens, recorder paper, fuses, and lamps.
2. The Contractor shall submit data on the expected life of consumable items with instructions for storage and shelf life duration. Include the name, address, and telephone number of two nearest local sources for each consumable item. Include the supplier's literature, a recent price list and grade of quality for each consumable item.
3. The Contractor shall provide a 1 year's supply of each consumable item associated with the specified, approved, and delivered equipment.

D. **Test and Maintenance Equipment**. Test equipment and special tools shall be provided by the Contractor to supplement the requirements of the process control system start-up, maintenance, and warranty procedures. Tools and test equipment shall be sufficient to maintain the computer monitoring and/or supervisory control system in good working order. Maintenance equipment shall include housekeeping supplies such as computer and monitor screen cleaners, tape/disk cleaner, level sensor cleaning agent, analyzer cleaning agents, electrolytes, membranes, etc.

1. Courses and laboratory work provided under training shall include instructions in the use and care of special tools and test equipment.

2. Test equipment shall be suitable for operation with frequencies and amplitudes of the voltages and currents in the digital equipment circuitry. The test equipment shall be available for use in routine maintenance, performance testing, and malfunction check-out. The equipment shall be used to check grounding, power supply voltages, calibration, accuracy of conversion circuitry for analog inputs, transmitter flow/levels/pressure/temperature, receiver sensitivity, and voltage drop.
3. The Contractor shall provide test equipment listed below. Items not listed but considered essential to proper hardware testing and maintenance by the Contractor shall also be provided.

    a. Digital multimeter of sturdy construction and of sufficiently broad application for the digital equipment system.

        1) Measures and generates milliamp, millivolt, and voltage signals.
        2) Simulates a two wire transmitter.
        3) Digital display.
        4) Accuracy shall be +-0.50 percent of range, or better.
        5) Measures continuity, resistance, capacitance, frequency, and diode checking function.
        6) Measures direct current and alternating current amperes.
        7) Measures and displays AC harmonics with a sample rate of one meg.

PART 2 - PRODUCTS

2.1 **GENERAL**. All equipment installed in wet locations shall be rated NEMA 4X.

2.2 **MATERIALS**

A. **General.** All materials shall be in accordance with the drawings and specifications. The following miscellaneous materials shall be furnished by the Contractor:

1. Mounting hardware as specified in Division 26 section "Supporting Devices."
2. Wire labels as specified in Division 26 section "Identification."
3. Nameplates as specified in Division 26 section "Identification."
4. Relays, timers, and pilot control devices as specified in Division 40 section "Control Devices."

B. **Terminal Blocks**

1. General. IEC style, corrosion resistant blocks, rail mounted rated for 300 volts minimum.
2. Terminals. Screw type, stainless steel wire clamp, nickel plated copper conductor bar, wire range of No. 20 to No. 10 AWG.
3. Accessories

a. Din rail.
b. End barriers and end anchors.
c. Knife disconnect isolating switches.
d. Fuse blocks with fuse puller for each.

4. Manufacturers. Subject to compliance with the requirements of this specification, available manufacturers of terminal blocks include, but are not limited to, the following:

a. Phoenix Contact
b. Buchanan.

C. **Power Supplies**

1. Regulated direct current (dc) power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one instrument loop.
2. Provide MOV type surge protectors on input and output. Each shall have visible indication of input and output, out of service.
3. Power supplies shall be suitable for 120 volt input with a variation of +- 10 percent, and the supply output shall be fused or short circuit protected.
4. Output voltage regulation shall be as required by the instrumentation equipment being supplied with a minimum of 0.1 percent.
5. Size and output voltage shall be as shown on the drawings or schedules.
6. Manufacturers. Subject to compliance with the requirements of this specification, available manufacturers of power supplies include, but are not limited to, the following:

a. Acopian Corporation.
b. Moore Industries.
c. Condor DC Power Supplies, Inc.

D. **Gauges and Snubbers**. Provide gauges and snubbers as specified in Division 22 section “Meters and Gauges.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Existing Conditions**. Examine the site and existing facilities. Compare the site and existing facilities with the drawings and specifications. With respect to the conditions of the premises, locate connections of existing facilities and any obstructions which may be encountered and conduct work to minimize disruption to existing conditions.

B. **Field Measurements**. Field verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and regulations, the contract documents, and the referenced standards.

3.2 INSTALLATION - GENERAL

A. **General**

1. Location of instruments shown on the drawings are approximate unless specifically dimensioned. The Contractor shall install the instruments to perform their intended function in full coordination with existing conditions and the work of other trades.
2. The Contractor shall furnish, fabricate, and mount all instrument stands and brackets. Mounting of stands and instruments shall be per installation detail drawings. All stands must be level, plumb, rigid, and free from vibration. Additional support shall be added where required for vibration free mounting.

B. **Instrumentation wiring is shown** schematically on the plan or described by narrative in the specifications. Contractor to provide type and quantity of wiring necessary to perform the function specified in Division 40 and shown on the plans. See Division 26 wire and cable sections for "uses permitted." Analog signal conductors and discrete signal conductors shall always be in separate conduits or cable tray compartments. Power wiring shall be in conduits and cable tray compartments separate from all signal wiring. Power wiring wherever required by instruments or equipment provided as part of the instrument system is work of this section.

1. The Contractor shall terminate field wiring for equipment specified under this section. The system integrator shall check instrument installation and field wiring before instrument devices are electrically powered by Contractor. Wires shall be terminated at terminal blocks with crimp type, preinsulated tongue lugs. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated. All signal shields shall have only one ground point which shall be located at the closest control panel. Seal around all conductors inside conduits as they enter equipment. Use watertight seal (closed cell RTU foam type) entering or leaving every building, box, or instrument. Install conduit water relief or "weep" on the system side of all seals to prevent intrusion of water into the equipment.
2. Spare Wiring. Signal and interlock wiring shall contain spare conductors in every raceway. Spare conductors shall be provided in pairs and shall be clearly and distinctly marked at every access point indicated where the pairs start and stop. The minimum number of spare pairs shall be 25 percent of the number of active pairs with a minimum of one spare pair.

C. **Threaded Connections**

1. Procedure.

    a. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
    b. Align threads at point of assembly.
    c. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

d. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

D. **Tagging**

1. All instrumentation equipment shall be provided with identification tags in accordance with the Process and Instrumentation Diagrams, Instrument Symbol sheets, and Section 26 05 53, "Electrical Identification." Each field instrument shall have a stainless steel tag. Identification tags shall be provided by L.E.E. Engraving services, Oakdale, Pennsylvania, or equal.
2. The device tags shall be mounted using stainless steel screws.

3.3 FIELD QUALITY CONTROL

A. **Piping Tests**. After piping systems have been put into service, inspect for leaks. Adjust pipes, valves, or fittings to stop leaks; replace equipment if leak persists.

B. **System Tests**

1. A technical representative of the system integrator and the Contractor shall participate in the checkout of instruments and control systems. If interrelated devices furnished by other suppliers, such as valve actuators, motor controls, chemical feeders, and primary measuring devices do not perform properly when placed in service, the Contractor shall correct the problem. If such correction cannot be made in a timely manner and the Owner agrees, a temporary test condition may be created. The technical representative may use suitable test equipment to introduce simulated signals from those devices; however, he shall be required to locate the source of any trouble or malfunction.

2. All special testing materials and equipment shall be provided by the Contractor. Where it is not practical to test with real process variables, the Contractor shall provide suitable means of input and output signals and control strategy simulation. The simulation techniques shall be subject to the approval of the Owner's Representative. Special tests shall meet the requirements of Division 1 Quality Control Services section.
3. Test Plans. Field testing shall be performed before the required demonstration. Specific test plans shall be written to cover all phases of field testing and shall include, but may not be limited to, the following:

   a. Describe the purpose of the tests, the test equipment required, and the step-by-step method of implementation necessary to accomplish the specified test as well as define the necessary test prerequisites.
   b. Provide drawings and figures that show the test equipment arrangement and the interconnection of test equipment to the portion of the equipment system under test.
   c. Include associated test data sheets which must be completed with the test data as each test progresses.
   d. The test program shall require satisfactory completion of the tests in sequence which shall demonstrate that the design

hardware and software procured and installed are effective and safe. As each phase of testing is completed, the test data sheets shall be signed and dated.

e. Submit the documented adjustments including modifications to the control and alarm settings, process engineering unit changes, limit switch settings, temperature switch settings, pressure switch settings, and torque switch settings.

f. Submit results of system test in a test data report.

C. **The device tags** shall be mounted using stainless steel screws.

3.4 ADJUSTING

A. **Set Points**. Alarm and control set points shall be adjusted to their operational values during the demonstration period.

B. **Calibration**. Calibration adjustments shall be performed during the demonstration period for an operational system. Testing shall commence after calibration verification for each instrument is provided to the Engineer.

3.5 CLEANING

A. **Instrumentation System**. The instrumentation system components shall be kept clean and free of dust during the storage, start-up, demonstration, and warranty period.

B. **Control Panels and Consoles**. Clean dust and dirt accumulation inside and outside control panels and consoles, on a monthly basis, during start-up and demonstration period.

3.6 DEMONSTRATION

A. **General.** When all required tests have been performed and prior to final approval, a qualified representative of the system integrator shall thoroughly demonstrate to the Owner's personnel the operation of the complete instrumentation and control system. Submit report data per Section 01 33 00.

B. **Operational Demonstration**. After the system tests have been performed and the Owner's Representative has reviewed the system test report data, the operational demonstration period may begin.

1. The Contractor shall perform an operational demonstration of the instrumentation and control system. Unless otherwise specified, the instrumentation and control system operational demonstration shall be a continuous 3 day (72 hour) period during which the work is operated and maintained in a continuously on-line, fully functional process state.
2. During the operational demonstration period, the following process conditions shall be performed.

    a. Throttle valves and/or adjust pump speeds to demonstrate the minimum, maximum, and normal flow, level, and pressure conditions of each flow, level, and pressure meter specified in Sections 40 91 03.04 and 40 91 02.02.

b. Demonstrate pressure switch and differential pressure transmitter operations specified in Section 40 91 01. Differential pressure transmitters with square root extractors shall be demonstrated with minimum, maximum, and normal flow conditions.

c. Demonstrate the operation of analytical instruments specified in Section 40 91 00. If the analytical instrument is used in a chemical feed loop, coordinate with the relevant Sections for proper operation of chemical feed equipment. Create unusual conditions to test for proper system and equipment connection. During the demonstration period, simulate specified alarm conditions.

d. All components in the instrument panels and consoles shall function properly during the demonstration period.

3.7 PROTECTION

A. **The Contractor** shall protect the instrumentation system components from water, dust, dirt, and corrosion during the start-up, demonstration, and warranty period.

3.8 INSTRUCTION OF OPERATING PERSONNEL

A. **Field Training**. Training shall be conducted in accordance with Section 01 79 02 and shall include equipment specified in this section, related electrical and interfaces to equipment provided by other division sections. Training sessions shall be conducted as follows:

1. Provide two (2) control system training sessions, each for five (5) four-hour days for both daytime and nighttime shifts (total of 40 hrs.) for five (5) staff members.
2. Provide two (2) field instrumentation training sessions, each for two (2) four-hour days for both daytime and nighttime shifts (total of 16 hrs.) for five (5) staff members.
3. The training program shall provide the plant treatment personnel with the capability of operating, maintaining, modifying, and upgrading the software of the process control system supplied.
4. Provide two post control system training sessions, each for two (2) four-hour days for both daytime and nighttime shifts (total of 16 hrs.) for five (5) staff members. This training shall be scheduled by the owner during the first 6 months after the system has been online.
5. Training courses shall include hardware components for emphasizing operation, maintenance, interface with other systems, and associated theory. Software training shall include the fundamental software organization, operation of the delivered system, program development, and usage of programming language.
6. Minimum Goals. Training shall incorporate operational requirements described in these specifications. Training shall provide the treatment plant personnel with the following:

    a. Process control system start-up and shutdown.
    b. Routine diagnostic checks and maintenance.
    c. Control set point and dead band modifications.

d. PID controller configuration.
e. Selection and interpretation of computer screen displays, printed logs, and reports.
f. Computer screen display additions, deletions, and modifications.
g. Printed log and report additions, deletions, and modifications.
h. Data base additions, deletions, and modifications.
i. Response to alarm displays and error indications.
j. Program software loading and backup of application.
k. Window make/winder viewer.
l. How to create new windows.
m. How to create new objects.
n. Demonstrate application manager.
o. Demonstrate toolbars and menu functions.
p. Demonstrate animation links.
q. Tag name dictionary and how to create tag names.
r. Real-time trending screen. Demonstrate a creation of a real-time trend.
s. Historical trending screen.
t. Alarm configuration. Demonstrate alarm configuration (set point, deadband, time delay, enable/disable, etc.)
u. Alarm query configuration.
v. Demonstrate how to setup the alarm paging software.
w. XL reporter/OPS demonstration.
x. Plant maintenance logs
y. Demonstrate how to setup security passwords at different levels.
z. Primary (maintenance) and backup (host) computer security.
aa. Demonstrate the automatic redundancy between the computers. Demonstrate how updating the SCADA host PC is done when new configuration has been made into the primary computer (development key).
bb. Operation and handling of data storage devices.
cc. Hard drive operation and maintenance.
dd. Equipment diagnostic testing and replacement of failed parts.

7. The process control system integrator shall submit a training program which provides the treatment plant personnel a theoretical background and a broad range of related skills to achieve the listed goals. The instructor(s) shall be experienced in system applications similar to the equipment specified herein. The resumes of the training staff for instructing the plant treatment personnel shall be available for review by the Owner. The plant treatment personnel trainees shall be subjected to program testing, evaluation, and counseling. Study assignments shall be made and later reviewed by the instructors to the satisfaction of class attendees. Trainees shall be encouraged to freely ask questions during the instruction periods.
8. The Contractor shall provide most classroom training courses at the process treatment plant site. Hands-on training shall be conducted at the Contractor's site which has a facility similar to the system described herein, as well as at the treatment plant. A minimum of three treatment plant trainees shall become qualified to check out, operate and maintain the process control system prior to delivery of the specified equipment to

the plant. Training shall continue after delivery and during checkout of the system.

9. Provide text material for self study and to supplement classroom lectures. The personnel attending the training courses shall be permitted to retain text materials for future reference.
10. The Contractor shall develop a training program tailored to the Owner's needs including type and quantity of treatment plant personnel, a curriculum of described courses, duration of courses, and training facilities. The Contractor shall submit for approval a detailed outline of the proposed training schedule, how the training courses are to be conducted, where various phases of the training will take place, and estimated dates for beginning and end of each training phase. The Contractor shall be responsible for the cost of the training program. The Owner shall be responsible for the trainee salaries and overhead costs. Remote site field training shall be within 50 highway miles from the treatment plant site.

B. **Factory Training.** Factory training for Rockwell Automation, tailored CCP299/143/152 - Studio 5000 Logix Designer, ControlLogix Fundamentals and Troubleshooting and Project Development shall be provided for total of three (3) staff members. The customized factory training course shall be a four and half-day course work at entry or intermediate level with course description as selected by the Owner. The training shall be conducted at the factory training facility or at the Owner's facility as selected by the Owner. Course material expenses for three (3) staff members shall be carried in the system integrators bid allowance as described in the bid forms.

3.9 SCHEDULES

A. **General**. Detailed information to augment specification data may be provided in the form of schedules or in lieu of schedules on ISA S20 specification forms. See each specification section for schedule or ISA specification forms.

B. **Power Supplies Schedule**

1. Application. Power supplies shall be provided to enable all equipment provided with and as a part of the Instrument System. If scheduled, such power supplies are understood to be specifically required, but not necessarily a comprehensive list of all power supplies to be provided.

C. **Gauges**

1. Application.

END OF SECTION

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SECTION 40 91 00

ANALYTICAL INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections.** Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional requirements related to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install analytical instruments in accordance with the plans and as specified herein.

B. **Types.** The types of equipment specified in this section include the following

1. Turbidity
2. Particle Counter
3. Chlorine Residual Analyzer
4. Sample Pump-Suction Lift
5. pH Analyzer

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to flow measurement equipment. Provide products and components which have been UL listed and labeled.
4. National Fire Protection Associations (NFPA) 820.
5. See the Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in the manufacture of analytical instruments whose products have been in satisfactory use in similar service for not less than 5 years.

2. Installer's Qualifications. Firm with at least 5 years of successful installation experience on projects with materials and equipment similar to items specified herein. An approved manufacturer's representative factory educated in maintenance, installation, and start-up of the analytical instrument equipment to be supplied.

1.4 **SUBMITTALS**

A. **General.** Furnish manufacturer's product data, test reports, and materials certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.

B. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished under this section.

1.5 **JOB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation System Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Storage and Protection**. The Contractor shall store the items furnished under this section until they can be installed. Such storage shall meet the requirements of the manufacturer and be approved by the Owner. Use all means necessary to protect the material of this section before, during, and after installation, and to protect the installed work and materials of all other trades.

1.7 **SPECIAL WARRANTY**. Refer to Section 40 90 00, "Instrumentation System Basic Requirements."

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Turbidity Analyzer**

1. Features.

a. Continuous type flow through sensor.
b. Operation on scattered light principle (surface scatter operation).
c. Integral bubble trap sensor.
d. Solid state analyzer in NEMA 4X enclosure.
e. Integral display.
f. Self-diagnostics with malfunction indication.
g. Bubble rejection circuitry.
h. Field serviceable noninteracting zero and span controls.
i. Two alarm outputs.
j. 4-20 mA output to plant SCADA system.

2. Accessories.

a. Mounting hardware.

3. Materials.

a. Sensor Wetted Parts. Plastic.

4. Sizes and Ratings.

a. Accuracy. 2 percent of reading from 0 to 60 nephelometric turbidity units (NTU). 5 percent of reading from 60 to 200 NTU.
b. Temperature Range. 0 to 40° C. (32 to 140° F.).
c. Sample Flow Range. 3.5 to 11.5 gallons per hour.
d. Contact Rating. 5 amps at 230 Vac.
e. Output Signal. 4-20 mA.
f. Input Power. 120 Vac.

5. Manufacturer.

a. Subject to compliance with the requirements of this specification, provide turbidity analyzers manufactured by one of the following:

1) Hach Company.

B. **Particle Counter Sensor and Analyzer**

1. Features

a. Continuous measurement.
b. Laser diode light source.
c. Light obscuration liquid particle counting sensor.
d. Four channel counter.
e. Liquid crystal display.
f. NEMA enclosure.
g. 4-20 mA analog transmission.
h. 2 µm detection limit at a 3:1 signal to noise ratio
i. Dynamic range of 2-400 µm.

2. Accessories

a. Mounting hardware and installation kit for mounting both the sensor and the analyzer.
b. Tracking software.
c. RS232 interface kit, includes converter, cable and 12 V dc power supply.

3. Manufacturer

a. Subject to compliance with the requirements of this specification, available manufacturers of particle counters include, but are not limited to, the following:

1) Hach Company
2) Rosemount Analytical, Inc.
3) Chemtrac Systems, Inc.

C. **Total Chlorine Residual Analyzer (Non-Reagent Type)**

1.Features.

a. Total Chlorine Measurement. Analyzer shall provide a continuous measurement of total chlorine in solution with pH integration. Analyzer must be able to read a measurement of zero without manual adjustment.
b. No additional of chemical reagents shall be required to measure the total chlorine.
c. Basic Sensing Element. Three electrode amperometric measuring cell.
d. pH Sensor. A pH sensor shall also be provided. pH display shall be 0.00-14.00.
e. Display: 4-digit, 0.75” numeric LCD with 12-digit second line, LED back light for visibility in dark.
f. Enclosure: Enclosures shall be provided for all equipment exterior to the tanks. Enclosures shall be NEMA 4X Non-metallic, unless noted otherwise.
g. Sensor Submergence. The sensor shall be submerged 2-3 feet below the water surface.
h. Conduit for sensor cable. Conduit shall be 1-inch 316 stainless steel. Length shall be as required for proper installation.
i. Interconnect Cable. Provide based on manufacturer’s recommendations. Contractor shall order cable at length required for installation.
j. Digital Communications. Ethernet to communicate with PLC.

2. Sizes and Ratings.

    a. Accuracy. 0.05 mg/L (ppm)
    b. Sample Rate. 8 to 10 liters per minute at 100 to 860 kilopascals (kPa) (15 to 125 pounds per square inch [psi]).
    c. Display Range 0-5.000 ppm
    d. Field selectable range or as specified in the schedule at the end of this section.
    e. Output Signal. 4-20 milliamperes (mA) for both Total Chlorine and pH.
    f. Input Power. 115-volt alternating current (Vac), 60 hertz, single phase.

3. Additional Components.

    a. One shelf spare
    b. Spare membranes and electrolytes for each analyzer
    c. Installation kit
    d. Maintenance kit
    e. Sample conditioning kit
    f. User Manual
    g.

4. Manufacturer. Subject to compliance with the specifications, provide chlorine residual analyzers manufactured by the following:

    a. ATI Model Q46-79PR
    b. Hach Model CLT10sc

D. **Sample Pump - Suction Lift**

1. General. Pump shall be the horizontal, self-priming, centrifugal type, capable of passing solids up to 3/8 inch in diameter. Pump shall have 1-1/2-inch NPT suction and discharge connection.

2. Casing. Pump and motor casings shall be cast iron epoxy coated or stainless steel.

3. Impeller. The impeller shall be self-cleaning open type of cast iron or stainless steel construction.

4. Bearings. Bearings shall be properly lubricated, antifriction ball type, and shall withstand all radial and thrust loads.

5. Seals. Seals shall be tungsten titanium carbide or carbon/ceramic faces and viton elastomers.

6. Shaft. Shaft shall be of stainless steel designed for the maximum operating load.

7. Motor. The pump motor shall be horizontal, totally enclosed, fan cooled, continuous duty, induction type suitable for 3 phase, 60 hertz, 480 volts. The motor shall not overload at any point on the pump curve. Motor shall be a minimum of 1/2 horsepower (hp). The sample pump shall have the necessary characteristics to perform under the following operating conditions:

   i. Capacity in Gallons per Minute. 4.

   ii. Total Dynamic Head in Feet. 105.

   iii. Static Suction Lift in Feet. 3.

B. **pH Analyzer**

1. Features.

   a. Continuous pH and Temperature Monitoring with 4-20 mA output signal for each. Probes shall be either rated explosion proof or intrinsically safe barriers.
   b. Immersible or flow through type as specified in the schedule at the end of this section.
   c. Automatic temperature compensation.
   d. Probe with reference electrode, end plates, and protective disc.
   e. Solid state transmitter in NEMA 4X enclosure.
   f. Integral indicator.
   g. Input/output signal isolation.
   h. Bar graph indication of cell reference contamination or degradation, with blinking feature to indicate cell replacement required.
   i. Easily replaced disposable electrode cartridges not needing recharged.
   j. Connections between the sensors and the controller shall be "plug and play."

2. Accessories.

   a. Maintenance kit for each unit with the following:

      1) Two measuring electrodes.
      2) Supply of reference electrode electrolyte.
      3) Three buffering solutions.
      4) Miscellaneous O rings, gaskets, and hardware.

3. Materials.

   a. Probe. Stainless steel.
   b. Probe Electrode Sleeve. Glass.
   c. Transmitter/Controller. Unit to be housed in a NEMA 4X metal enclosure with corrosion-resistant finish.

4. Sizes and Ratings.

    a. Temperature Limits. 60 degrees Celsius (° C.) (140 degrees Fahrenheit [° F.]) at 35 psi.
    b. Pressure Limits. 100 psi at 38° C. (100° F.).
    c. Signal Output. 4-20 mA direct current (dc).
    d. Input Power. 120 Vac.
    e. Range as specified in the schedule at the end of this section.

5. Manufacturer.

    a. Subject to compliance with the requirements of this specification, available manufacturers of pH analyzers include, the following or approved equal:

        1) Hach.
        2) YSI

C. **Gravity Filter Backwash Monitoring System**

1. Ultrasonic Media Level, Media Expansion and Backwash Turbidity Instrument
    a. Instrument Category. Analytical
    b. Instrument Type. Media Level and Expansion Instrument and Backwash Turbidity
    c. Power Supply
        1) Controller: 100 to 240 VAC, 50/60 Hz (Optional 24 VDC)
        2) Power Supply Unit: 100 to 240 VAC, 50/60 Hz (Optional 24 VDC)
        3) Sensor: Supplied by Controller or Power Supply Unit.
    d. **Signal Output.** 4-20 mA into 600 ohm max. load; RS-485 Modbus RTU Protocol
    e. **Process Connection.** Sensor – ¾ inch FNPT
2. Measurement
    a. **Purpose.** The purpose of this instrument is to measure the depth of media, media expansion during backwashing, and backwash turbidity measurement in a granular media filter. The media depth and expansion measurement technique is underwater ultrasonic capable of providing continuous measurements. The turbidity measurement technique is 900 surface scatter pulsed LED light source.
3. Equipment Components
    a. **General.** The system shall consist of microprocessor-based Smart Sensor(s), Controller(s), Power Supply Unit(s), interconnecting cable, mounting brackets and hardware.
4. Smart Sensor
    a. The primary element shall be a microprocessor-based ultrasonic Smart Sensor operating in the range of 550kHz to 750kHz and

shall include a fully integrated 900 surface scatter pulsed LED turbidity meter with ambient light compensation. Sensors shall be implemented in a multiple sensor Field Network. Sensors shall receive power from the Controller or a Power Supply Unit that they are connected to and shall receive programming instructions from the Controller.

b. The Smart Sensor shall have a self-cleaning wiper mechanism consisting of a synthetic wiper and stainless steel shaft. The wiper mechanism shall be powered by a Controller or a Power Supply Unit and shall be capable of removing bubbles, slime and other material accumulations from the surface of the sensor.

5. Controller
   a. The Controller shall consist of a multi-function graphical user interface with integral membrane switch for instrument programming, measurement indication, and other instrument functions. It shall supply power to a sensor, and provide connections necessary to effect instrument communication.
   b. The Controller shall be capable of being fitted with a cell modem to facilitate remote factory start-up and technical support when such service is specified as an option. The cell modem feature shall enable remote programming and control of the Smart Sensor(s).
6. Power Supply Unit
   a. The Power Supply Unit shall consist of a power supply and communications hub. It shall supply power to a sensor, and provide connections necessary to effect instrument communication.
7. Option Cell Modem Factory Service
   a. When included as an option, the Controller shall be fitted with a cellular modem with activated cell service for a specified period of time. During the coverage time, the supplier shall provide remote factory start-up and technical support in accordance with the terms of the Cell Modem Factory Service Agreement.
8. Networked Instrument Configuration
   a. Smart Sensors shall be interlinked into a wired Field Network by twisted pair cable originating at the Controller and proceeding in daisy-chain fashion to each Power Supply Unit in the network. The network shall be comprised of Smart Sensors, one Controller, and Power Supply Units in quantity that together with the Controller equal the number of sensors in the network. If the installation consists of more than sixteen (16) sensors, the equipment shall be arranged in multiple networks, each consisting of no more than sixteen (16) sensors.
9. Performance
   a. Media Level & Expansion
      1) Measurement Range: 1.0 ft. to 32.0
      2) Resolution: 0.12 in. at 10.0 ft.
      3) Accuracy: 0.1 ft. at 10.0 ft.
      4) Dead Zone: 1.0 ft. from face of Sensor

b.Backwash Turbidity
1) Range: 0-50 NTU
2) Accuracy – 1% @ 50 NTU
3) Repeatability – 1% @ 50 NTU

c.Operating Temperature
1) Controller: -40°F to +140°F
2) Power Supply Unit: -40°F to +140°F
3) Sensor: 34°F to +125°F

10. Communications & Measurements Indications
    a. Smart Sensor
        1) RS-485 Modbus RTU protocol
        2) (2) 4-20mA Current Loop into Max. 600 ohms
            a) (1) User Assignable to Media Level, Media Expansion, or Expansion as a Percent of Expandable Media Depth
            b) (1) Factory Assigned to Backwash Turbidity
    b. Controller
        1) Display - 320 x 240 Backlit Graphical Monochrome (2.6 x 3.45 in. viewing area)
        2) Measurement Indications.
            a) Media Depth and Media Expansion in Engineering Units
            b) Media Expansion as a percent of Expandable Media.
        3) RS-485 Modbus RTU protocol, RS-232 Modbus protocol
        4)Terminal for Sensor 4-20mA Current Loop
    c. Power Supply Unit
        1) Display – None
        2) RS-485 Modbus RTU protocol
        3) Terminal for Sensor 4-20mA Current Loop
11. Mechanical
    a. Smart Sensor
        1) ABS and epoxy, IP68
        2) Dimensions
            a) Wiper Sensor, 5.75 x 2.95 in.
            b) Wiper Sensor with Turbidity, 5.75 x 2.95 in.
    b. Controller
        1) NEMA 4X, IP65 Polycarbonate Encolsure
        2) Dimensions: 9.25 x 9.0 x 4.5 in.
    c. Power Supply Unit
        1) NEMA 4X, IP65, PolyCarbonate Enclosure
        2) Dimensions: 7.125 x 7.125 x 2.375 in.
12. Power Requirements
    a. **Smart Sensor.** 15VDC, 20W (Provided by Controller or Power Supply Unit)
    b. **Controller.** 100-240 VAC, 50/60 Hz (1A); 24 VDC (Optional)
    c. **Power Supply Unit.** 100-240 VAC, 50/60 Hz (1A); 24 VDC (Optional)
13. Implementation

a. The sensor shall be constructed of materials suitable for the environment in which it is installed. The sensor shall be positioned in the filter or other tank and installed in accordance with manufacturer recommendations. The sensor is to be located above the filter media and submerged below the top of the backwash trough.

14. Manufacturer
    a. Analytical Technology, Inc. Entech Design FilterSmart Media Expansion and Backwash Turbidity Analyzer or approved equivalent.
    b. (Specify equipment configuration detail, including sensor model in the Instrument List and the P&ID drawings.)

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions**. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. **Discrepancies**. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. **Protection**

1. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
2. Provide blocking and cushioning materials to prevent damage during shipment.
3. Provide temporary lifting lugs on shipping package as needed.
4. Include approximately 1 pint of touch-up paint for each finish color in shipment.

B. **Surface Preparation**. The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.3 INSTALLATION

A. **General**

1. Coordinate the installation of in-line process analytical instruments with the installation of process piping equipment. Provide pressure reducing

valves, valves and piping to isolate analyzer instrument for calibration and maintenance.

2. Mount instruments so that they may be readily approached and easily serviced. Provide snap action clamps, etc., to allow easy removal from the process for in-bucket calibration or testing.
3. Furnish and install .polypropylene panel wall panel (minimum 48" x 36' x .375") mounted with corrosion resistant fasteners in Lab Room near new sample sink. Provide continuous from valve connection to filter effluent line to provide continuous supply line to each analyzer, and provide piped drainage to floor drain.

B. **Turbidity Analyzer**

1. Install immersible type sensors per the contract drawings.
2. Flow through type sensor shall be oriented as shown on contract drawings.

.

C. **Particle Counter**

1. Install immersible type sensors per the contract drawings.
2. Flow through type sensor shall be oriented as shown on contract drawings.

D. **Total Chlorine Residual**

1. Install immersible type sensors per the contract drawings.
2. Flow through type sensor shall be oriented as shown on contract drawings.

E. **Sample Pump.** Install pump as shown per the contract drawings.

F. **pH Analyzer**

1. Install immersible type sensors per the contract drawings.
2. Flow through type sensor shall be oriented as shown on the isometric or contract drawings.

3.4 FIELD QUALITY CONTROL

A. **Inspection**

1. Upon completion of this portion of the work, the Contractor shall provide for services of a qualified representative of the manufacturer to inspect and approve the installation.

B. **Calibration**

1. The manufacturer's representative shall furnish all necessary labor, materials, tools, and equipment required to calibrate each analytical instrument.

C. **Tests**

1. Upon completion of all inspections, and prior to acceptance by Owner, perform field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.5 DEMONSTRATION

A. **General.** When all required tests have been performed and prior to final approval, a qualified representative of the supplier shall thoroughly demonstrate to the Owner's personnel the operation of all items installed under this section in accordance with Section 40 90 00 .

3.6 SCHEDULE

A. BACKWASH ANALYZER

Tag No.	Location	Quantity	Notes
AIT-112A	Filter #1A	1	
AIT-112B	Filter #1B	1	
AIT-212A	Filter #2A	1	
AIT-212B	Filter #2B	1	
AIT-312A	Filter #3A	1	
AIT-312B	Filter #3B	1	
AIT-412A	Filter #4A	1	
AIT-412B	Filter #4B	1	
AIT-512A	Filter #5A	1	
AIT-512B	Filter #5B	1	
AIT-612A	Filter #6A	1	
AIT-612B	Filter #6B	1	

B. **TURBIDITY**

Tag No.	Location	Quantity	Notes
AIT/AE-109A	Filter #1A	1	
AIT/AE-109B	Filter #1B	1	
AIT/AE-209A	Filter #2A	1	
AIT/AE-209B	Filter #2B	1	
AIT/AE-309A	Filter #3A	1	
AIT/AE-309B	Filter #3B	1	
AIT/AE-409A	Filter #4A	1	
AIT/AE-409B	Filter #4B	1	
AIT/AE-509A	Filter #5A	1	
AIT/AE-509B	Filter #5B	1	
AIT/AE-609A	Filter #6A	1	
AIT/AE-609B	Filter #6B	1	

C. **CHLORINE RESIDUAL ANALYZER**

Tag No.	Location	Quantity	Notes
AIT/AE-521	Clearwell Chamber No. 3B	1	
AIT/AE-793	Chlorine Contact Tank No. 1 (North)	1	
AIT/AE-794	Chlorine Contact Tank No. 2 (South)	1	
AIT/AE-707	Finished Water Discharge Header	1	

D. **FLUORIDE ANALYZER**

Tag No.	Location	Quantity	Notes
AIT/AE-421	Chlorination Chamber	1	
AIT/AE	Finished Water Discharge Header	1	

E. **WEIGHT TRANSMITTERS**

Tag No.	Location	Quantity	Notes
WIT-1003	Day Tank for Fluoride Building	1	
WIT-1030	Chlorine 1-Ton Containers	1	Remove and replace existing transmitters.
WIT-1040	Chlorine 1-Ton Containers	1	Remove and replace existing transmitters.

END OF SECTION

SECTION 40 91 01

PRESSURE MEASUREMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section

B. **Related Sections**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional requirements related to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install pressure measurement equipment in accordance with the contract drawings and as specified herein.

B. **Types.** The types of equipment specified in this section include the following:

1. Pressure transmitter.
2. Gauge pressure transmitter

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with pressure measurement equipment in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to pressure measurement equipment. Provide products and components which have been UL listed and labeled.
4. See Section 40 90 00, "Instrumentation System Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of pressure measurement equipment whose products have been in satisfactory use in similar service for not less than 7 years.
2. Installer's Qualifications. Qualified with at least 7 years of successful installation experience on projects with pressure measurement equipment similar to that required for this project. An approved manufacturer's

representative factory educated in maintenance, installation, and start-up of the pressure measurement equipment. **SUBMITTALS**

C. **General.** Furnish manufacturer's product data, test reports, and material certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.

D. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

E. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished under this section.

1.4 **JOB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.5 **DELIVERY, STORAGE, AND HANDLING**

A. **Packing and Shipping**. Deliver equipment properly packaged and mounted on pallets or skids to facilitate handling of heavy items. Utilize factory fabricated type containers or wrappings for components which protect equipment from damage.

1.6 **SPECIAL WARRANTY**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Differential Pressure Transmitter**

1. Features.

a. Sensing element protected by a sealing diaphragm with silicone oil fill solution.
b. Microprocessor based transmitter.
c. Integral span and zero adjustments.
d. Electrically erasable programmable read only memory module and programmable transmitter configuration for flow applications.
e. Internal dampening
f. Two wire operation.
g. Square root or linear output, software selectable.
h. NEMA 4 enlcosure.
i. Two ½ inch NPT pressure connections.
j. Analog to digital and digital to analog converters.
k. Remote and local testing and configuration via digital signal superimposed on the 4-20 mAdc signal.

2. Accessories.

   a. Include stainless steel block and bleed valve, tubing, and fittings.
   b. Manual air release with threaded fitting for attachment of portable calibration unit.
   c. Local indicated reading in engineering units.
   d. Stainless steel tag.
   e. Flanged mounted hardware.

3. Materials.

   h. Sensor. Type 316 stainless steel with Viton O-rings.
   i. Mounting Hardware. Stainless Steel.
   c. Base and Cover. Die cast low copper aluminum with epoxy based finish and Buna O-rings.

4. Sizes and Ratings.

   a. Overpressure Protection. 2,320 pounds per square inch gauge (psig) minimum.
   b. Accuracy. +-0.2 percent of span.
   c. Ambient Temperature. -20 to 180 degrees Fahrenheit (^{o} F.).
   d. Pressure Input Range. As specified in the schedule at the end of this section.
   e. Signal Output. 4-20 milliampere direct current (mAdc).
   f. Ranges as specified in the schedule at the end of this section.

5. Manufacturer.

   a. Subject to compliance with the requirements of this specification, available manufacturers of level transmitters include, but are not limited to, the following:

      1) Foxboro.
      2) Emerson (Rosemount Inc.)
      3) Siemens
      4) ABB

6. Flow Application Accessories.

   a. Square root extractor integrally mounted in differential pressure transmitter.
   b. Local indicator reading in engineering units of flow.
   c. Three valve manifold, tubing, and fittings.

7. Loss of Head Application Accessories.

   a. Filter sediment trap, mudleg, and strainer assembly with air relief and drain valve.
   b. Local indicator reading in engineering units.

c. Tubing and fittings.
d. Isolation valve(s).
e. Three valve manifold, tubing, and fittings.

B. **Pressure Switch**

1. Features.

a. Pressure switch type. Gauge pressure, unless otherwise specified in the schedule at the end of this section.
b. Bourdon tube, diaphragm, or disc spring element as specified in schedule at end of this section.
c. Field adjustable set point over full range by means of external, tamperproof, calibrated dials.
d. Two independent isolated single-pole, double-throw (SPDT) (or SPST field convertible) contacts.
e. Adjustable deadband between 4 and 10 percent of full scale.
f. Screw type terminals.
g. 1/4-inch internal NPT process connections.
h. 3/4-inch internal NPT for conduit connection.
i. NEMA 4, 7, or 9 enclosure as specified in schedule at end of this section.

2. Accessories.

a. Pulsation dampener, tubing, and fittings.
b. Stainless steel tag.

3. Materials.

a. Bourdon Tube Element. 316 stainless steel.
b. Diaphragm and Disc Spring Element. Buna-N, Teflon, 316 stainless steel, Hastelloy C, or beryllium copper.
c. Other Wetted Parts. Stainless steel or anodized aluminum.

4. Sizes and Ratings.

a. Pressure range as specified in schedule at end of this section.
b. Quantity of switches and set points as specified in schedule at end of this section.
c. Set Point Accuracy. □1 percent of span.
d. Contacts. 5 amperes at 120 volts alternating current (Vac).

5. Manufacturer.

a. Provide pressure switches manufactured by one of the following:

1) United Electric Controls Company.
2) Barksdale, Inc.
3) Automatic Switch Company.

4) SOR Inc.

b. Available manufacturers of pressure switches include, but are not limited to, the following:

1) United Electric Controls Company.
2) Barksdale, Inc.
3) Automatic Switch Company.
4) SOR Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions**. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. **Discrepancies.** In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. **Protection**

1. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
2. Provide blocking and cushioning materials to prevent damage during shipment.
3. Provide temporary lifting lugs on shipping package as needed.
4. Include approximately 1 pint of touch-up paint for each finish color in shipment.

B. **Surface Preparation.** The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.3 INSTALLATION

A. **General**. Coordinate the installation of in-line process pressure elements with the process piping elements.

A. **Differential Pressure Transmitter.**

1. Install three valve manifold, ½ inch copper tubing with fittings and air release for attachment of portable calibration unit.

2. Mount transmitters on 2 inch pipe supports fabricated for floor or bracket mounting.
3. Install transmitter in an orientation where the sensing diaphragms are in a vertical plane and the exposure to shock, heat, and vibration is at a minimum.
4. Flow Applications. Differential pressure transmitter shall be mounted below the primary flow element device.
5. Loss of Head Applications. Provide tubing and pressure tap connection to the primary, filter effluent, flow element device.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Upon completion of this portion of the work, the Contractor shall provide for services of a qualified representative of the manufacturer to inspect and approve installation.

B. **Calibration**

1. Verify calibration on field-calibrated devices using calibrated test equipment.

C. **Tests**. Upon completion of all inspections and prior to acceptance by Owner, perform field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.5 DEMONSTRATION

A. **General**. Before required tests may be performed, the Contractor, along with a qualified representative of the instrument supplier, shall thoroughly demonstrate to the Engineer and to the Owner's personnel the operation and maintenance of all items provided under this section.

B. **Features**. Reliable and accurate operation of each pressure sensor and all specified accessories shall be demonstrated. This shall include accuracy, stability, and repeatability as specified over a range inclusive of the maximum (full scale, overflow, high alarm, etc.) and the minimum (low alarm, low stop) pressures which can occur without operator intervention.

C. **Continuity**. Once a pressure sensor has demonstrated the specified features and accuracy, it shall demonstrate continuity of performance for three continuous successive days. The pressure sensor shall intentionally be exposed to conditions which provide the full range of variations. At a minimum, one daily excursion to high alarm and one daily excursion to low alarm shall be arranged. Each day during the demonstration an hourly validation of accuracy and all accessories shall be made by the Owner's Representative. The Contractor shall provide the equipment necessary for the Owner's Representative to manually validate the pressure. Nighttime validation shall occur as arranged by the Owner and Engineer. Any performance outside specified performance or any failure of any accessory shall cause the complete 3-day performance demonstration to begin again.

D. **Recording**. Each pressure sensor being demonstrated by the Contractor shall be individually recorded on a 24 hour paper chart with minimum 4 inches of scale length. Discrete sensors shall be temporarily connected to provide a recording showing "on-off" changes in the sensor. Recording meters shall be certified accurate, demonstrated accurate, and provided by the Contractor for testing of the provided pressure sensors.

PART 4 - SCHEDULE

A. PRESSURE TRANSMITTER

Tag No.	Location	Quantity	Range (PSI)	Notes
PIT/PI-R103	Wellfield Pump #1	1	5-150	Discharge Piping
PIT/PI-R203	Wellfield Pump #2	1	5-150	Discharge Piping
PIT/PI-R303	Wellfield Pump #3	1	5-150	Discharge Piping
PIT/PI-R403	Wellfield Pump #4	1	5-150	Discharge Piping
PIT/PI-R503	Wellfield Pump #5	1	5-150	Discharge Piping
PIT/PI-R603	Wellfield Pump #6	1	5-150	Discharge Piping
PIT/PI-R703	Wellfield Pump #7	1	5-150	Discharge Piping
PIT/PI-R803	Wellfield Pump #8	1	5-150	Discharge Piping
PIT/PI-R903	Wellfield Pump #9	1	5-150	Discharge Piping
PIT/PI-R1003	Wellfield Pump #10	1	5-150	Discharge Piping
PIT/PE-538	Filter Air Scour Blower			
PIT-520	Finished Water Surge Relief Vault	1	5-150	Discharge Piping
PIT-710A	Backwash Pump	1	5-150	Discharge Piping
PIT-759	Backwash Pump	1	5-150	Discharge Piping
PIT-718	High Service Pump #1	1	5-150	Discharge Piping
PIT-728	High Service Pump #2	1	5-150	Discharge Piping
PIT-738	High Service Pump #3	1	5-150	Discharge Piping
PIT-748	High Service Pump #4	1	5-150	Discharge Piping
PIT-758	High Service Pump #5	1	5-150	Discharge Piping
PIT-706	High Service Pump Finished Water Discharge Header	1	5-150	Discharge Piping
PIT107A	Filter #1A	1	1-50	
PIT107B	Filter #1B	1	1-50	
PIT207A	Filter #2A	1	1-50	
PIT207B	Filter #2B	1	1-50	
PIT307A	Filter #3A	1	1-50	
PIT307B	Filter #3B	1	1-50	
PIT407A	Filter #4A	1	1-50	
PIT407B	Filter #4B	1	1-50	
PIT-507A	Filter #5A	1	1-50	
PIT-507B	Filter #5B	1	1-50	
PI-529	Filter Air Scour Blower #1	1	1-50	

PI-535	Filter Air Scour Blower #2	1	1-50	
PIT-607A	Filter #6A	1	1-50	
PIT-607B	Filter #6B	1	1-50	
PIT-611	Filter-to-Waste Pump	1	1-150	

B. PRESSURE SWITCHES

Tag No.	Location	Quantity	Range (PSI)	Notes
PSH-528	Filter Air Scour Blower #1	1	0-15	
PSH-534	Filter Air Scour Blower #2	1	0-15	
PSL-781	High Service Pump #1	1	5-150	
PSH-781	High Service Pump #1	1	5-150	
PSL-782	High Service Pump #2	1	5-150	
PSH-782	High Service Pump #2	1	5-150	
PSL-783	High Service Pump #3	1	5-150	
PSH-783	High Service Pump #3	1	5-150	
PSL-784	High Service Pump #4	1	5-150	
PSH-784	High Service Pump #4	1	5-150	
PSL-785	High Service Pump #5	1	5-150	
PSH-785	High Service Pump #5	1	5-150	
PSL-115A1	Filter #1A	1	1-50	
PSL-115A2	Filter #1A	1	1-50	
PSL-115A3	Filter #1A	1	1-50	
PSL-115A4	Filter #1A	1	1-50	
PSL-115B1	Filter #1B	1	1-50	
PSL-115B2	Filter #1B	1	1-50	
PSL-115B3	Filter #1B	1	1-50	
PSL-115B4	Filter #1B	1	1-50	
PSL-215A1	Filter #2A	1	1-50	
PSL-215A2	Filter #2A	1	1-50	
PSL-215A3	Filter #2A	1	1-50	
PSL-215A4	Filter #2A	1	1-50	
PSL-215B1	Filter #2B	1	1-50	
PSL-215B2	Filter #2B	1	1-50	
PSL-215B3	Filter #2B	1	1-50	
PSL-215B4	Filter #2B	1	1-50	
PSL-315A1	Filter #3A	1	1-50	
PSL-315A2	Filter #3A	1	1-50	
PSL-315A3	Filter #3A	1	1-50	
PSL-315A4	Filter #3A	1	1-50	
PSL-315B1	Filter #3B	1	1-50	

PSL-315B2	Filter #3B	1	1-50	
PSL-315B3	Filter #3B	1	1-50	
PSL-315B4	Filter #3B	1	1-50	
PSL-415A1	Filter #4A	1	1-50	
PSL-415A2	Filter #4A	1	1-50	
PSL-415A3	Filter #4A	1	1-50	
PSL-415A4	Filter #4A	1	1-50	
PSL-415B1	Filter #4B	1	1-50	
PSL-415B2	Filter #4B	1	1-50	
PSL-415B3	Filter #4B	1	1-50	
PSL-415B4	Filter #4B	1	1-50	
PSL-515A1	Filter #5A	1	1-50	
PSL-515A2	Filter #5A	1	1-50	
PSL-515A3	Filter #5A	1	1-50	
PSL-515A4	Filter #5A	1	1-50	
PSL-515B1	Filter #5B	1	1-50	
PSL-515B2	Filter #5B	1	1-50	
PSL-515B3	Filter #5B	1	1-50	
PSL-515B4	Filter #5B	1	1-50	
PSH-611	Filter-to-Waste Pump	1	1-150	
PSL-615A1	Filter #6A	1	1-50	
PSL-615A2	Filter #6A	1	1-50	
PSL-615A3	Filter #6A	1	1-50	
PSL-615A4	Filter #6A	1	1-50	
PSL-615B1	Filter #6B	1	1-50	
PSL-615B2	Filter #6B	1	1-50	
PSL-615B3	Filter #6B	1	1-50	
PSL-615B4	Filter #6B	1	1-50	
PSL-1032	Chlorine 1-Ton Cylinder	1	1-50	
PSL-1042	Chlorine 1-Ton Cylinder	1	1-50	

C. PRESSURE INDICATOR

Tag No.	Location	Quantity	Range (PSI)	Notes
PI-529	Filter Air Scour Blower #1	1	0-15	
PI-535	Filter Air Scour Blower #2	1	0-15	

END OF SECTION

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SECTION 40 91 02.02

LEVEL MEASUREMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section

B. **Related Sections**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional requirements related to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install level measurement equipment in accordance with the contract drawings and as specified herein.

B. **Types.** The types of equipment specified in this section include the following:
1. Float switches.
2. Electrode level switch.
3. Ultrasonic level transmitter.
4. Radar level transmitters.
5. Submersible level transmitters.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with level measurement equipment in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to level measurement equipment. Provide products and components which have been UL listed and labeled.
4. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of level measurement equipment whose products have been in satisfactory use in similar service for not less than 5 years.
2. Installer's Qualifications. Qualified with at least 5 years of successful installation experience on projects with level measurement equipment

similar to that required for this project. An approved manufacturer's representative factory educated in maintenance, installation, and start-up of the level measurement equipment.

1.4 **SUBMITTALS**

A. **General.** Furnish manufacturer's product data, test reports, and material certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.

B. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished under this section.

D. **Calibrations**. Furnish two certified copies of calibrations.

1.5 **JOB CONDITIONS.** Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Packing and Shipping**. Deliver equipment properly packaged and mounted on pallets or skids to facilitate handling of heavy items. Utilize factory fabricated type containers or wrappings for components which protect equipment from damage.

1.7 **SPECIAL WARRANTY.** Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Float Switches**

1. Features.

a. Differential/wide angle type (for pump start/stop) and standard floats (for level alarms).
b. Hermetically sealed and eccentrically weighed float housing.
c. Tilt type, SPDT mercury switch.
d. Heavy duty, flexible, submersible cable connected to float with watertight seal. Length as specified in the schedule at the end of this section.

2. Accessories.

   a. Enamel finished cast iron weight kit, bolt assembled to float cable.
   b. Intrinsically safe relays.

3. Materials.

   a. Float. Polypropylene or 316 stainless steel, as listed in schedule at the end of this section.
   b. Cable Jacket. Polyvinyl chloride (PVC).

4. Sizes and Ratings.

   a. Switch. 5 amperes minimum at 120 volts alternating current (Vac).
   b. Environmental Limitations. Suitable for use with ambient and process fluid temperatures.

5. Manufacturers.

   a. Subject to compliance with the requirements of this specification, provide float level switches manufactured by one of the following:

      1) Consolidated Electric Company.
      2) Flygt Corporation.

B. **Electrode Level Switch**

1. Features.

   a. Electrode.

      1) Rod Type. 1/4 inch diameter with threaded end length as required, to deflect wet floor alarm.
      2) Metallic bar inside protective plastic shield.

   b. Control Relay.

      1) Solid state plug-in module. (To be mounted inside local PLC panel)
      2) Field adjustable sensitivity.
      3) DPDT output contacts.

2. Accessories.

   a. Electrode Holders. NEMA 4X, non-matallic assembly with insulating sleeve, screw terminal for wiring termination.
   b. Relay Enclosure. NEMA 4X, non-metallic wall mounted.
   c. Ground connection for proper electrode operation.

d. Stainless steel tag.

3. Materials.

a. Rod Type Electrode. Type 316 stainless steel.

4. Sizes and Ratings.

a. Sensitivity. 0 to 1 megohm.
b. Primary Voltage. 120 Vac.
c. Secondary Voltage. 12 Vac.
d. Contact Rating. 10 amps.
e. Lengths, Elevations, and Quantities. As specified in the schedule at the end of this section.

5. Manufacturer.

a. Subject to compliance with the requirements of this specification, available manufacturers of electrode level switches include, but are not limited to, the following:

1) B/W Controls.
2) Warrick Controls, Inc.
3) US Filter

C. **Ultrasonic Level Transmitter**

1. Features.

a. Transducer.

1) Transmits ultrasonic pulses to measured surface and receives reflected pulses. Beam to be 7 degree cone, centerline to beam edge.
2) Corrosion and submergence resistant.
3) Suspended rigid conduit or American National Standards Institute (ANSI) 150 pound flange mounted as specified in schedule at the end of this section.

b. Transmitter.

1) NEMA 4X housing for wall or pipe mounting as specified in schedule at the end of this section.
2) Solid state microprocessor based.
3) Integral keypad and alphanumeric display for programming/configuring and monitoring unit.
4) EMI filter.
5) Adjustable minimum acceptable signal return level.
6) Acoustical noise rejection.
7) Zero and span adjustments.
8) Hold last good signal circuitry.

9) Loss of echo and equipment fault indication.
10) Electronic adjustable signal dampening.
11) Thermostatically controlled strip heater.

2. Accessories.

a. Adjustable transducer mounting bracket.
b. Foam rubber (closed cell) lined columnating tube.
c. Stainless steel tag.

3. Materials.

a. Mounting Hardware. 316 Stainless steel.

4. Sizes and Ratings.

a. Temperature compensation over operating temperature range of -20 to 180 degrees Fahrenheit (^{o} F.) without recalibration.
b. Level range as specified in schedule at end of this section.
c. Accuracy. ±1.0 percent of the maximum range.
d. Linearity and Repeatability. 1 percent or less.
e. Input Power. 24 VDC over signal leads.
f. Signal output. Isolated 4-20 mAdc.

5. Manufacturer.

a. Subject to compliance with the requirements of this specification, available manufacturers of sonic level transmitter include, but are not limited to, the following:

1) Miltronics, Inc.
2) Endress and Hausser Instruments.

B. **Radar Level Transmitters**

1. Features.

a. Transducer.

1) Transmits microwave pulses to measured surface and receives reflected pulses. Beam to be 7 degree cone, centerline to beam edge.
2) Corrosion and submergence resistant.
3) Suspended rigid conduit or American National Standards Institute (ANSI) 150 pound flange mounted as specified in schedule at the end of this section.

b. Transmitter.

1) NEMA 4X housing for wall or pipe mounting as specified in schedule at the end of this section.
2) Solid state microprocessor based.

3) Integral keypad and alphanumeric display for programming/configuring and monitoring unit.
4) EMI filter.
5) Adjustable minimum acceptable signal return level.
6) Acoustical noise rejection.
7) Zero and span adjustments.
8) Hold last good signal circuitry.
9) Loss of signal and equipment fault indication.
10) Electronic adjustable signal dampening.
11) Thermostatically controlled strip heater (outdoor application).
12) Built-in adjustable alarm relays.
13) FCC compliance.

2. Accessories.

a. Adjustable transducer mounting bracket.
b. Foam rubber (closed cell) lined columnating tube.
c. Stainless steel tag.

3. Materials.

a. Mounting Hardware. 316 Stainless steel.

4. Sizes and Ratings.

a. Temperature compensation over operating temperature range of -20 to 180 degrees Fahrenheit (^{o} F.) without recalibration.
b. Level range as specified in schedule at end of this section.
c. Accuracy. ±1.0 percent of the maximum range.
d. Linearity and Repeatability. 1 percent or less.
e. Input Power. 120VAC.
f. Signal output. Isolated 4-20 mAdc.

5. Manufacturer.

a. Subject to compliance with the requirements of this specification, available manufacturers of sonic level transmitter include, but are not limited to, the following:

1) Siemens.
3) Endress and Hauser Instruments.
4) Rosemount/Emerson.
5) Or an approved equal.

C. **Submersible Sensor Level Transmitters**

1. Features.

b. Wide diaphragm silicon pressure cell with isolated diaphragm for chlorinated water application.

c. Two wire transmitter.
d. Reverse polarity and surge protected.

2. Accessories.

a. 6 inch Schedule 40 PVC stilling well, perforated with 3/8 inch holes at 6" on centers along its length, stainless steel cross bolts to hold sensor exactly at X" above floor and mounting hardware as required.
b. Jacketed, shielded cable with breather tube (50') and suitable moisture protection.
c. Intrinsically safe barriers.
d. Factory supplied surge protection and moisture trap devices mounted in NEMA 4X box as required.
e. Supply one pressure calibration jig for each supplied sensor.

3. Materials.

a. Stainless steel case and diaphragm.
b. Stainless steel mounting hardware.
c. Polypropylene or polyurethane cable jacket
d. Stainless steel cable suspension mounting hardware with 20lbs SS weight kit .

4. Sizes and Ratings.

a. Accuracy. ±0.1 percent full scale.
b. Temperature Effect. ±1 percent output change for ±25 degree Celsius (^{o} C.).
c. Compensated Temperature Range. 0 to 50° C.
d. Operating Temperature. -20 to 70^{o} C.
e. Range. As specified in the schedule at the end of this section.
f. Output. 4-20 mAdc.
g. Electronics. Signal conditioning and transient protective electronics mounted in a NEMA 4X reinforced polyester housing.

4. Subject to compliance with the requirements of this specification, provide submersible level transmitters manufactured by the following:

a. KPSI
b. Endress & Hauser.
c. Or approved equal.

D. **Ultrasonic Level Transmitter**

6. Features.

g. Transducer.

2) Transmits ultrasonic pulses to measured surface and

receives reflected pulses. Beam to be 7 degree cone, centerline to beam edge.

3) Corrosion and submergence resistant.
4) Suspended rigid conduit or American National Standards Institute (ANSI) 150 pound flange mounted as specified in schedule at the end of this section.

h. Transmitter.

1) NEMA 4X housing for wall or pipe mounting as specified in schedule at the end of this section.
2) Solid state microprocessor based.
3) Integral keypad and alphanumeric display for programming/configuring and monitoring unit.
4) EMI filter.
5) Adjustable minimum acceptable signal return level.
6) Acoustical noise rejection.
7) Zero and span adjustments.
8) Hold last good signal circuitry.
9) Loss of echo and equipment fault indication.
10) Electronic adjustable signal dampening.
11) Thermostatically controlled strip heater (outdoor application).
12) Built-in adjustable alarm relays.

7. Accessories.

a. Adjustable transducer mounting bracket.
b. Foam rubber (closed cell) lined columnating tube.
c. Stainless steel tag.

8. Materials.

a. Mounting Hardware. 316 Stainless steel.

9. Sizes and Ratings.

a. Temperature compensation over operating temperature range of -20 to 180 degrees Fahrenheit (^{o} F.) without recalibration.
b. Level range as specified in schedule at end of this section.
c. Accuracy. ±1.0 percent of the maximum range.
d. Linearity and Repeatability. 1 percent or less.
e. Input Power. 120VAC.
f. Signal output. Isolated 4-20 mAdc.

10. Manufacturer.

a. Subject to compliance with the requirements of this specification, available manufacturers of sonic level transmitter include, but are not limited to, the following:

1) Miltronics, Inc.
2) Endress and Hausser Instruments.
3) Or an approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions**. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. **Discrepancies**. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. **Protection**

1. All equipment and materials shall be packaged at the factory to protect each item from damage during shipment and storage.
2. Provide blocking and cushioning materials to prevent damage during shipment.
3. Provide temporary lifting lugs on shipping package as needed.
4. Include approximately 1 pint of touch-up paint for each finish color in shipment.

B. **Surface Preparation**. The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.3 INSTALLATION

A. **General**

1. Install equipment as indicated in accordance with manufacturer's written instructions and in compliance with recognized industry practices.
2. Mount instruments so that they may be readily approached and easily serviced.
3. Install transmitters with local indicators in a position readily observable from the operating area.
4. Level Measurement Installation.

    a. Coordinate the installation of level sensing devices with the process equipment and contract drawings.
    b. Install manufacturer's supplied cable between level element and transmitter. If flexible conduit is not provided or where

conditions dictate, furnish and install rigid conduit sized according to manufacturer's recommendations.

c. Install ground references as required by the manufacturer for the application.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Upon completion of this portion of the work, the Contractor shall provide for services of a qualified representative of the manufacturer to inspect and approve installation.

B. **Tests**. Upon completion of all inspections and prior to acceptance by Owner, perform field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.5 ADJUSTING

A. **Calibration**. Perform calibration adjustments of each level device as needed for a complete operational system.

3.6 CLEANING

A. **Level Measurement**. Each level device shall be kept clean and free of dust during the storage, start-up, demonstration, and warranty period.

3.7 DEMONSTRATION

A. **General**. Before required tests may be performed, the Contractor, along with a qualified representative of the instrument supplier, shall thoroughly demonstrate to the Engineer and to the Owner's personnel the operation and maintenance of all items provided under this section.

B. **Features**. Reliable and accurate operation of each level sensor and all specified accessories shall be demonstrated. This shall include accuracy, stability, and repeatability as specified over a range inclusive of the maximum (full scale, overflow, high alarm, etc.) and the minimum (low level alarm, low level stop) levels which can occur without operator intervention.

C. **Continuity**. Once a level sensor has demonstrated the specified features and accuracy, it shall demonstrate continuity of performance for three continuous successive days. The level sensor shall intentionally be exposed to conditions which provide the full range of variations in level. At a minimum, one daily excursion to high level alarm and one daily excursion to low level alarm shall be arranged. Each day during the demonstration an hourly validation of accuracy and all accessories shall be made by the Owner's Representative. The Contractor shall provide the equipment necessary for the Owner's Representative to manually validate the level. Nighttime validation shall occur as arranged by the Owner and Engineer. Any performance outside specified performance or any failure of any accessory shall cause the complete 3 day performance demonstration to begin again.

D. **Recording**. Each level sensor being demonstrated by the Contractor shall be individually recorded on a 24 hour paper chart with minimum 4 inches of scale length. Discrete sensors shall be temporarily connected to provide a recording showing "on-off" changes in the sensor. Recording meters shall be certified accurate, demonstrated accurate, and provided by the Contractor for testing of the provided level sensors.

3.8 **SCHEDULE**. See following pages. To be completed prior to bidding.

A. FLOAT SWITCH

Tag No.	Description	Process	Probe Mounting
LSH-112A	Filter 1-4 Flume High Level	Aerated Water	XXX
LSL-112B	Filter 1-4 Flume Low Level	Aerated Water	XXX
LSH-806	East Aerator Bldg Meter Vault High Level	Raw Water	XXX
LSH-XXX	West Aerator Bldg Meter Vault High Level	Raw Water	XXX
LSH-425	Influent Distribution Box (Water Influent)	Aerated Water	XXX
LSH515	Influent Distribution Box (Overflow)	Aerated Water / Filter-to-Waste	XXX
LSL-514A	Filter 5-6 Flume Low Level	Aerated Water	XXX
LSH-514B	Filter 5-6 Flume High Level	Aerated Water	XXX
LSL-520A	Filter Gallery Sump Low Level	Sump	XXX
LSH-520B	Filter Gallery Sump High Level	Sump	XXX
LSL-701A	Pump Chamber No. 1 (South) Clearwell Low Level	Finished Water	XXX
LSH-701B	Pump Chamber No. 1 (South) Clearwell High Level	Finished Water	XXX
LSL-702A	Pump Chamber No. 2 (North) Clearwell Low Level	Finished Water	XXX
LSH-702B	Pump Chamber No. 2 (North) Clearwell High Level	Finished Water	XXX
LSH-1004	Pumpout Sump High Level	Fluorsilicic Acid / Storm	XXX
FS-1005	Chlorine Eyewash Alarm	Finished Water	XXX
FS-1006	Fluoride Eyewash	Finished Water	XXX
LSH-1007	Containment Sump High Level	Fluorsilicic Acid	XXX

B. ELECTRODE LEVEL SWITCH

Tag No.	Location	Mounting	Range (Depth of Well to Floor)	Depth from Bottom Well to Max Water Level

C. ULTRASONIC LEVEL TRANSMITTER

Tag No.	Location	Mounting	Range (Depth of Well to Floor)	Depth from Bottom Well to Max Water Level
LT/LE – R101	Wellfield Pump #1 Level Transmitter	XXX	XXX	XXX
LT/LE-R201	Wellfield Pump #2 Level Transmitter	XXX	XXX	XXX
LT/LE-R302	Wellfield Pump #3 Level Transmitter	XXX	XXX	XXX
LT/LE-R401	Wellfield Pump #4 Level Transmitter	XXX	XXX	XXX
LT/LE-R501	Wellfield Pump #5 Level Transmitter	XXX	XXX	XXX
LT/LE-R601	Wellfield Pump #6 Level Transmitter	XXX	XXX	XXX
LT/LE-	Wellfield Pump #7 Level Transmitter	XXX	XXX	XXX

R701				
LT/LE-R801	Wellfield Pump #8 Level Transmitter	XXX	XXX	XXX
LT/LE-R901	Wellfield Pump #9 Level Transmitter	XXX	XXX	XXX
LT/LE-R1001	Wellfield Pump #10 Level Transmitter	XXX	XXX	XXX
LIT-424	Influent Distribution Box (Water Influent)	XXX	5.0	3.5
LIT 514	Influent Distribution Box (Overflow)	XXX	5.0	3.5
LIT/LE-811	East Aerator Clearwell Level Indicator Transmitter	XXX	18.5	16.0
LIT-911	West Aerator South Clearwell Level Indicator Transmitter	XXX	18.0	16.0
LIT-912	West Aerator North Clearwell Level Indicator Transmitter	XXX	18.0	16.0
LT/LE-1001	Fluoride Tank #1 Level Transmitter	XXX	12.0	11.0
LT/LE-1002	Fluoride Tank #2 Level Transmitter	XXX	12.0	11.0
LIT/LE-701C	Pump Chamber No. 1 (South) Clearwell Level Indicator Transmitter	XXX	25.0	22.5
LIT/LE-702C	Pump Chamber No. 2 (North) Clearwell Level Indicator Transmitter	XXX	25.0	22.5
LIT/LE-703	Chlorination Chamber Level Indicator Transmitter.	XXX	20.0	17.5
LE-517	Backwash Reservoir Level Element	XXX	XXX	XXX
LT-112	Filter 1-4 Flume Level Transmitter	XXX	XXX	XXX
LT-514	Filter 5-6 Flume Level Transmitter	XXX	XXX	XXX
LT-110A	Filter #1A Level Transmitter	XXX	11.25	9.25
LT-110B	Filter #1B Level Transmitter	XXX	11.25	9.25

LT-210A	Filter #2A Level Transmitter	XXX	11.25	9.25
LT-210B	Filter #2B Level Transmitter	XXX	11.25	9.25
LT-310A	Filter #3A Level Transmitter	XXX	11.25	9.25
LT-310B	Filter #3B Level Transmitter	XXX	11.25	9.25
LT-410A	Filter #4A Level Transmitter	XXX	11.25	9.25
LT-410B	Filter #4B Level Transmitter	XXX	11.25	9.25
LT-510A	Filter #5A Level Transmitter	XXX	11.25	9.25
LT-510B	Filter #5B Level Transmitter	XXX	11.25	9.25
LT-610A	Filter #6A Level Transmitter	XXX	11.25	9.25
LT-610B	Filter #6B Level Transmitter	XXX	11.25	9.25

D. RADAR LEVEL TRANSMITTERS

Tag No.	Location	Mounting	Range (Depth of Well to Floor)	Depth from Bottom Well to Max Water Level

E. SUBMERSIBLE LEVEL SENSOR TRANSMITTER

Tag No.	Location	Mounting	Range (Depth of Well to Floor)	Depth from Bottom Well to Max Water Level

END OF SECTION

SECTION 40 91 03.04

FLOW MEASUREMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections.** Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional requirements related to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install flow measurement equipment in accordance with the contract drawings and as specified herein.

B. **Types.** The types of equipment specified in this section include the following:

1. Magnetic flowmeter and transmitter.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with flow measurement equipment in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to flow measurement equipment. Provide products and components which have been UL listed and labeled.
4. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of flow measurement equipment whose products have been in satisfactory use in similar service for not less than 5 years.
2. Installer's Qualifications. Qualified with at least 5 years of successful installation experience on projects with flow measurement equipment similar to that required for this project. Also, an approved

manufacturer's representative factory educated in maintenance, installation, and start-up of the flow measurement equipment.

3. All flow meters shall be factory calibrated with NIST certified and traceable calibration flow equipment, of not less than 3 test points.

1.4 **SUBMITTALS**

A. **General**

1. All submittals shall be submitted in accordance with the Division 1 submittal requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Product Data**

1. General. Furnish manufacturer's product data, test reports, and material certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.
2. Materials List. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.
3. Wiring Diagrams. Submit wiring diagrams showing all connections for all equipment furnished under this section.

C. **Submittal Package No. 2 – Field Verification Reports**

1. Furnish two certified copies of field calibrations.

1.5 **JOB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Packing and Shipping.** Deliver equipment properly packaged and mounted on pallets or skids to facilitate handling of heavy items. Utilize factory fabricated type containers or wrappings for components which protect equipment from damage. Comply with Section 01 60 00, "Materials and Equipment."

1.7 **SPECIAL WARRANTY**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Magnetic Flowmeters**

1. Features.

a. Pulsed direct current (dc) electromagnetic induction meter.

b. Flow Tube.

1) Enclosure.

a) NEMA 6p capable of withstanding full-time submergence, with manufacturer's field potting kit. All Magnetic Flowmeters shown in the schedule in Paragraph 3.8.A of this Section, except for the four 1-inch polymer Magnetic Flowmeters, shall be NEMA 6P rated. The meters shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics or interruption of the flow measurement. The meters shall be protected by epoxy paint.

b) Designed to meet Class I, Division 2, NEC requirements.

2) End Connections. 150-pound flanged ends.

3) End Connections. 1/2- or 3/4-inch NPT with watertight seals on cable entrance.

4) Fluid Property Effects. Accuracy unaffected by changes in fluid velocity, density, pressure, temperature, or conductivity (above minimum conductivity limit).

c. Signal Converter.

1) Construction. Solid state.
2) Interchangeability. Capable of being interchanged with any magnetic flowmeter or signal converter of the type specified herein without affecting accuracy or requiring circuit modifications or recalibration.
3) Low flow cutoff and positive zero return when activated by a remote contact closure.
4) Mounting. Wall and pipe stand.
5) Enclosure. NEMA 4X.
6) Local Indication. Integrally mounted linear scale in engineering units. Minimum 2-inch scale length. Digital Indicators. Illuminated, 1/4-inch high digits, 1 percent resolution, permanent tag including full scale reading and units. If integral units cannot meet this specification, then adjacent units are to be provided. Limit digital display to one decimal.

7) Transmitter shall include a readable chip with all factory-calibrated parameters (K-factors, offsets, etc.) in a read-only fashion, as well as field ranging factors (4-20 range, damping, pulse scaling, etc.) in a read-write fashion.

2. Accessories.

a. Lifting lug on the top of each meter flange, where applicable.
b. Shielded cable assemblies for connection between flowmeter and signal converter for both electrodes and coils.
c. Grounding rings of a metallic material compatible with the process fluid.
d. Grounding straps.
e. Integral case heaters with thermostat and NEMA 4X enclosure for signal converters in outdoor locations.
f. Stainless steel tag.

3. Materials.

a. Body and Tube.

1) Flowmeter 4 Inches and Smaller. Stainless steel.
2) Flowmeters Larger than 4 Inches. Carbon steel.
3) Housing: Epoxy coated aluminum.

b. Liner. Rubber or polyurethane or as specified in schedule at end of this section.

c. Electrodes. Tantalum or 316 stainless steel.

d. Grounding Rings. 316 stainless steel.

e. Exterior Finish. Corrosion resistant epoxy.

f. Signal Converter Enclosure. NEMA 4X with stainless steel mounting hardware.

4. Sizes and Ratings.

a. System Accuracy. □2.0 percent of rate from 0 to 10 percent of range; 0.5 percent of rate from 10 to 100 percent of range.
b. System Repeatability. □1.0 percent of rate in 10 to 100 percent flow range.
c. Drift. Complete zero stability.
d. Minimum Fluid Conductivity Limit. 5 microsiemens per centimeter or higher.

e. Ambient Temperature Range. -20 to 150 degrees Fahrenheit (^{o} F.) for signal converter, +5^{o} F. to +150^{o} F. for flowmeter.
f. Process Fluid Temperature: 190^{o} F. maximum.
g. Range Adjustment. Continuously adjustable from 1 to 31 feet per second (fps).
h. Signal Output. 4-20 milliamperes direct current (mAdc) isolated into 0 to 750 ohms, isolated.
i. Power Requirements. 120 volts alternating current (Vac) +10 percent, 60 hertz (Hz), 30 watts (W) maximum.
j. Size and flow range as specified in the schedule at the end of this section.

5. Manufacturer.

a. Subject to compliance with the requirements of this specification, provide magnetic flowmeter manufactured by one of the following or approved equal:

1) Endress-Hauser
2) Foxboro Company.
3) Rosemount, Inc.
4) Krohne.
5) ABB

B. **Velocity Averaging Pitot Type Flow Sensor and Transmitter**

1. Features

1) Hot Tap. Equipment must be installed on an active finished water main with no disruption to service.

2) Flow Element Sensing Tube

1) Retractable
2) Hot Tap
3) 316 stainless steel
4) Mounting coupling shall be compatible with process pipe material
5) Bullet shaped cross section
6) Solid, threaded, one-piece solid welded construction with dual chambers
7) Array of sensing ports located on both sides of the element – total of 15
8) Leading edge shall be roughened
9) Sealing of packing shall be separate from the loading mechanism
10) Shut off valves and connections suitable for connection to a transmitter.

11) Accuracy shall be within +/- 1% of actual flowrate over a minimum flow turndown of 10:1. Repeatability of flow test shall be within +/- 0.1%. Supply tests from independent laboratories to verify.
12) Unrecovered pressure loss shall be equal to or less than 3% of the developed differential pressure.

3) Threaded Assembly

1) Safety spring lock assembly type
2) Horizontal pipe orientation
3) 600# ANSI equivalent (1440 psig @ 100 deg. F)
4) Direct mount transmitter – transmount
   a) Smart differential pressure transmitter
   b) Signal Outputs. 4-20 milliamperes direct current (mAdc)
   c) ¼" process connections on 2 – 1/8" centers
   d) Range – 0-0.5 to 0-30" W.C.
   e) Direct mount to sensing tube
5) Three (3) valve manifold – stainless steel

4) Accessories

1) Weld coupling (CS)
2) Close nipple (stainless steel)
3) 2" Access ball valve (stainless steel)
4) Screw drive (stainless steel threaded rod)
5) Access nipple (stainless steel)
6) Anti-seize orbital bearing
7) Packing gland (stainless steel)
8) Instrument head (stainless steel)
9) Armstrong 11AV float automatic air vent valve (stainless steel)

2. Manufacturer

1) Provide velocity averaging pitot type flow sensor manufactured by one of the following:

1) Veris, Inc. (Verabar V200S-15-H-B8S-F-F3HS)
2) Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions.** Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. **Discrepancies.** In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. Protection

1. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
2. Provide blocking and cushioning materials to prevent damage during shipment.
3. Provide temporary lifting lugs on shipping package as needed.
4. Include approximately 1 pint of touch-up paint for each finish color in shipment.

B. **Surface Preparation.** The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.3 INSTALLATION

A. General

1. Coordinate the installation of in-line process flow elements with the installation of process piping equipment.
2. Install straight lengths of pipe on either side of flowmeter as recommended by the manufacturer unless otherwise noted on the contract drawings. Coordinate actual installation location with Contractor installing piping before piping layouts are submitted.
3. Mount instruments so that they may be readily approached and easily serviced.
4. Install transmitter with local indicators in a position that the operator can observe the indicator from the operating area.

3.4 FIELD QUALITY CONTROL

A. **Calibration.** The Contractor shall furnish labor, materials, tools, and equipment required to calibrate the flowmeters. Calibration shall be performed under conditions of constant flow. Refer to specific product requirements for additional calibration requirements.

B. **Inspection**. Upon completion of this portion of the work, the Contractor shall provide for services of a qualified representative of the manufacturer to inspect and approve installation.

C. **Tests**. Upon completion of all inspections, and prior to acceptance by Owner, perform field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.5 ADJUSTING

A. **Calibration.** Perform calibration adjustments of each flow device as needed for a complete operational system.

3.6 CLEANING

A. **Flow Measurement.** Each flow device shall be kept clean and free of dust during the storage, start-up, demonstration, and warranty period.

3.7 DEMONSTRATION

A. **General**. Before required tests may be performed, the Contractor, along with a qualified representative of the instrument supplier, shall thoroughly demonstrate to the Engineer and to the Owner's personnel the operation and maintenance of all items provided under this section.

B. **Features**. Reliable and accurate operation of each meter and all specified accessories shall be demonstrated. This shall include accuracy, stability, and repeatability as specified over a 10 to 1 flow range.

C. **Continuity**. Once a meter has demonstrated the specified features and accuracy, it shall demonstrate continuity of performance for three continuous, successive days. The meter shall intentionally be exposed to conditions which provide the full range of variations of flow supply. At a minimum, one daily excursion to maximum flow and one daily excursion to minimum flow shall be arranged. The minimum duration of these extreme flows shall be 5 minutes if a series meter is used or the time required to meter a geometrically measurable flow (GMF) volume. The "5 minute" flow option requires a series meter to validate the flowmeter performance. The series meter(s), if not available as part of the permanent system, shall be provided by the Contractor for this demonstration. Each day during the demonstration an hourly validation of accuracy and all accessories shall be made by the Owner's Representative. Nighttime validation shall occur as arranged by the Owner and Engineer. Any performance outside specified performance or any failure of any accessory shall cause the complete 3 day performance demonstration to begin again. The "5 minute" flow option shall be the assumed case for every meter unless a meter is clearly listed "GMF" in the specifications.

PART 4 - SCHEDULE

A. **Magnetic Flow Element and Transmitter**.

Tag No.	Size (inches)	Flow Range (gpm or as noted)	Process Fluid	Process Description	Pipe Material	Pipe Connections Required	Location
FIT/FE-R102	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #1
FIT/FE-R202	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #2
FIT/FE-R302	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #3
FIT/FE-R402	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #4
FIT/FE-R502	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #5
FIT/FE-R602	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #6
FIT/FE-R702	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #7
FIT/FE-R802	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #8
FIT/FE-R902	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #9
FIT/FE-R1002	12	10-3,500	Raw Water	Discharge Piping	DIP	Flanged	Wellfield Pump #10
FIT/FE-810	24	10-9,000	Raw Water	Influent to East Aerator Bldg.	DIP	Flanged	East Aerator Building
FIT/FE-910	24	10-9,000	Raw Water	Influent to West Aerator Bldg.	DIP	Flanged	West Aerator Building
FIT/FE-127	8	2,000 scfm	Air	Blower System	SST	Flanged	Filter Scour Blower
FIT/FE-705	4	10-9,000	Finished Water	Water Supply to Chlorinators	DIP	Flanged	Backwash and Recirculation Pumps
FIT/FE-706	30	10-9,000	Finished Water	XXX	XXX	XXX	Backwash and Recirculation Pumps
FIT/FE-709	XXX	XXX	XXX	XXX	XXX	XXX	Backwash and Recirculation

							Pumps
FIT/FE-710	18	10-6,500	Finished Water	Water Supply to Washwater, Surface Wash, & Plant Water	DIP	Flanged	Backwash and Recirculation Pumps
FIT/FE-706	24	10-17,000	Finished Water	Water Supply to Distribution System	DIP	Flanged	High Service Discharge Header
FIT/FE-106A	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #1A
FIT/FE-106B	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #1B
FIT/FE-206A	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #2A
FIT/FE-206B	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #2B
FIT/FE-306A	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #3A
FIT/FE-306B	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #3B
FIT/FE-406A	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #4A
FIT/FE-406B	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #4B
FIT/FE-506A	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #5A
FIT/FE-506B	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #5B
FIT/FE-606A	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #6A
FIT/FE-606B	10	5-3,000	Filtered Water	Filtered Water to Clearwells	DIP	Flanged	Filter #6B
FIT/FE-610	6	1-500	Filter-to-Waste	Filter-to-Waste Pump	DIP	Flanged	Filter-to-Waste Pump

B. **Velocity Averaging Pilot Type Flow Sensor and Transmitters**

Tag No.	Size (inches)	Flow Range (gpm)	Process Fluid	Process Description	Pipe Material	Pipe Connections Required	Location

END OF SECTION

SECTION 40 91 04

GAS DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional requirements related to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install analytical instruments in accordance with the plans and as specified herein, including all necessary appertaining work and materials, whether specifically identified or not.

B. **Types.** The types of equipment specified in this section include the following:

1. Combustible Gas Detector – Methane.
2. Hydrogen Sulfide Detector – H2S

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to pressure measurement equipment. Provide products and components which have been UL listed and labeled.
4. See Section 40 90 00, "Instrumentation System Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of pressure measurement equipment whose products have been in satisfactory use in similar service for not less than 5 years.
2. Installer's Qualifications. Qualified with at least 5 years of successful installation experience on projects with pressure measurement equipment similar to that required for this project. An approved manufacturer's

representative factory educated in maintenance, installation, and start-up of the pressure measurement equipment.

1.4 **SUBMITTALS**

A. **General.** Furnish manufacturer's product data, test reports, and material certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.

B. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished under this section.

1.5 J**OB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

D. **Storage and Protection**. The Contractor shall store the items furnished under this section until they can be installed. Such storage shall meet the requirements of the manufacturer and be approved by the Owner. Use all means necessary to protect the material of this section before, during, and after installation, and to protect the installed work and materials of all other trades.

1.7 S**PECIAL WARRANTY**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Methane Gas and H2S Detectors**

1. Description of System
   a. A permanently installed continuously operating gas detection system consisting of a Control Monitors to be installed where shown on the drawings. Remote mounted XP rated gas sensor/detector head(s) to be provided as shown on the drawings. Remote warning lights to be provided at each entrance door as shown on the drawings.
   b. Upon detection of petroleum vapor or hydrogen sulfide gas or low oxygen, the system shall function as follows:
2. When set point is reached, it shall:
   a. activate warning relay
   b. illuminate local indicator light(s)
   c. sound audible horn
   d. Activate the remote warning lights.
3. Equipment
   a. The gas monitors shall continuously measure and display the

concentrations of Combustible Petroleum vapor and Hydrogen Sulfide.

b. The Gas Monitors shall consist of a three-point monitor and shall be contained in a plastic, general-purpose enclosure designed to meet NEMA 4X.

c. Monitors Requirements

1) Monitor Operating Requirements

a) Operating Voltage - The monitor shall operate between 7-30 VDC and an internal 110 VAC power supply shall be provided.

b) The monitor shall have a reset connector and button for resetting latched alarms.

c) Set-up and start-up of the monitor will be such that the enclosure need not be opened during this process.

d) The monitor shall be factory-calibrated and ready for out-of-box use. A gas check is all that is required to ensure proper operation.

e) The monitor output signal shall have the capability to provide the following output:

- Modbus RTU output, industry standard Modbus RTU format, and Prosoft third-party tested and compliant.
- An isolated 4-20madc signals proportional to the measured methane, and H2S.
- Relay output (dry contacts) for each methane, H2S, and alarms

2) Monitor Display

a) There will be a local display indicating the gas type being monitored and the concentration of gas present. The display will alternate between the sensors.

b) The monitor display shall indicate all diagnostic check/fault conditions with a scrolling message detailing the condition. Error codes shall not be used.

c) The monitor will display three levels of alarm. Alarm levels will be adjustable by means of a hand-held infrared controller. The display will be visible from a distance of five feet and will be present at all times. It will not be required to be turned on or off. This readout will be a three and one-half inch (3 1/2") digit Liquid Crystal Displays (LCDs).

3) Smart Sensor Technology

a) Sensors shall be contained in sensor modules mounted external to the main enclosure.

b) Sensor modules shall contain all relevant sensor information within the module. This

information shall include the sensor manufacturer name.

c) Sensor modules shall store all calibration data so that the modules may be calibrated off-site and installed in the field without the necessity of re-calibration. The sensor modules shall not require a battery or power source to store this data.

d) The electrochemical sensors shall not require the periodic addition of reagents.

4) Multi-Sensing Capabilities

a) The monitor shall operate up-to two sensors at one time.

b) Combinations of electrochemical, and Combustible infrared sensing technologies shall be accommodated.

(1.) Infrared Combustible Sensors/Transmitters

- The infrared (IR) combustible sensors must be capable of calibration without gas. The sensors/transmitters must be capable of performing a full calibration by zero adjustment only.
- The IR sensors/transmitters shall detect for an above 100%LEL condition (over-range). This condition must be indicated on the front panel LCD.
- The IR sensors/transmitters shall not contain a flashback arrestor / frit.
- The IR sensors/transmitters must allow for a gas check without alternate calibration / gas check fittings or cap.
- The IR sensors only shall meet IP-67 approval for high moisture conditions including a built in heater.

(2.) The electrochemical sensors/transmitters shall not require the periodic addition of reagents.

c) The sensor units shall be located remotely from the monitor/readout unit. Wiring between sensors and monitor/readout units shall be as required by system manufacturer. Wire size shall be adequate for length of run required (100'+/-) and increased in size as required. The sensors shall be capable of being mounted up to 3000 feet from the monitor enclosure with optional remote power supply

d) Remote sensors shall be provided with explosion proof junction box.

e) Each remote sensor shall have the capability of being powered with either 110/220VAC or 12/24VDC power.

5) Sensing Element Warranty

a) All sensing elements (sensors) shall have a minimum useful life of two years. The supplier shall provide replacement sensors at no charge for any sensor that does not meet the minimum requirement.

6) Non-Intrusive Calibration Capability

a) All monitors shall be capable of being calibrated without opening any enclosures. The use of flashlight-type devices, magnets or clamp-on devices to achieve calibration is not acceptable.

b) There shall be an option to calibrate the sensor through a push-button actuator. The push-button shall allow for zero, span and iCAL capabilities.

c) A small non-intrusive hand held wireless remote control shall let the user only perform sensor zeroing, calibration and setting the multiplex address.

d) A larger non-intrusive hand held wireless remote control shall let the user not only do the functions of the small remote control but activate all functions and features of the sensor/transmitter.

7) LED/Relay

a) The monitor shall have LEDs, viewable from 50 feet, minimum.

b) The monitor shall have four common adjustable relays. Relays shall be rated at five amps @ 30VDC, five amps @ 220VAC, single-pole, double-throw and consist of three for alarm levels and one for fault per sensor.

8) Power Supply Requirements

a) Internal Power Supply Monitor shall be integrally powered by built-in supply 85-256 VAC / 24 VDC.

9) Battery Backup
a) An internal battery backup shall provide a minimum of 4 hours operation for up to three sensors depending on the type of sensors.

d. Manufacturer Capability Requirements - As a minimum, the gas monitoring equipment manufacturer must meet the following requirements:
1) The manufacturer must be capable of supplying all equipment used to check or calibrate the monitor units.
2) The manufacturer must be capable of providing on-site service with factory-trained personnel.
3) The manufacturer must be capable of providing on-site training for owner/operator.
4) The manufacturer must be capable of providing replacement parts within 24 hours.

e. Provide ten (10) red remote warning lights/rotating beacons, 120 VAC, weatherproof.

4. Manufacturer:
a. This specification is based on the MSA TriGard Monitor.
b. Acceptable manufacturers are MSA and Analytical Technology Inc. (ATI), or products of equal or better quality, function and performance.

B. CHLORINE GAS DETECTION
1. Refer to Specification 46 31 11 for requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions**. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. **Discrepancies.** In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. **Protection**

1. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
2. Provide blocking and cushioning materials to prevent damage during shipment.
3. Provide temporary lifting lugs on shipping package as needed.
4. Include approximately 1 pint of touch-up paint for each finish color in shipment.

B. **Surface Preparation.** The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.3 INSTALLATION

A. **Gas Detection Units**

1. Install at location on drawings and specified herein.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Upon completion of this portion of the work, the Contractor shall provide for services of a qualified representative of the manufacturer to inspect and approve installation.

B. **Calibration.** Verify calibration on field calibrated devices using calibrated test equipment.

C. **Tests**. Upon completion of all inspections and prior to acceptance by Owner, perform field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.5 DEMONSTRATION

A. **General**. Before required tests may be performed, the Contractor, along with a qualified representative of the instrument supplier, shall thoroughly demonstrate to the Engineer and to the Owner's personnel the operation and maintenance of all items provided under this section.

3.6. SCHEDULE

A. **GAS DETECTOR**

Tag No.	Analyzer Location	Mounting	Enclosure Type
AIT-1036	Chlorine Cylinder Room	Wall	NEMA 4X
AIT-1037	Chlorinator / Distribution Room	Wall	NEMA 4X

END OF SECTION

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SECTION 40 91 05

TEMPERATURE MEASUREMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional requirements related to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install pressure measurement equipment in accordance with the contract drawings and as specified herein.

B. **Types.** The types of equipment specified in this section include the following:

1. Temperature transmitter.
2. Temperature sensors.
3. Temperature switches.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work associated with pressure measurement equipment in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to pressure measurement equipment. Provide products and components which have been UL listed and labeled.
4. See Section 40 90 00, "Instrumentation System Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in manufacture of temperature measurement equipment whose products have been in satisfactory use in similar service for not less than 7 years.
2. Installer's Qualifications. Qualified with at least 7 years of successful installation experience on projects with temperature measurement equipment similar to that required for this project.

1.4 **SUBMITTALS**

A. **General.** Furnish manufacturer's product data, test reports, and material certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.

B. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished under this section.

1.5 **JOB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Packing and Shipping**. Deliver equipment properly packaged and mounted on pallets or skids to facilitate handling of heavy items. Utilize factory fabricated type containers or wrappings for components which protect equipment from damage.

1.7 **SPECIAL WARRANTY**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Temperature Transmitter**

1. Features.

a. Solid-State converter that powers the RTD circuit and converts the sensor signal to a 4 to 20mA signal.
b. RTD input configurable to 100 ohm Platinum RTD with either 0.00385 or 0.00392 coefficient.
c. Ambient temperature limits: -40 to 85 degrees Farenheit.
d. Accuracy +/- 0.2% of calibrated span, including repeatability, hysteresis, linearity and adjustment resolution (not including sensor error).
e. Output: 4 to 20mA 24 VDC.
f. Display: Integral local display of temperature and operating parameters.
g. Electronics: Solid-State with build in EMI and RFI protection.
h. Input/output isolation.
i. Field adjustable span and zero settings.
j. Electronics housing designed and constructed to meet NEMA 4X requirements and equipped with brackets suitable for pipe stand and wall mounting remote from the RTD Sensor assembly.
k. Conduit connections: ¾-inch NPT

2. Accessories.

   a. Include any required power supply. 120 VAC available.
   b. Handheld programmer if required.

3. Manufacturer.

   a. Subject to compliance with the requirements of this specification, provide temperature transmitters manufactured by one of the following or approved equal:

      1) Invensys/Foxboro
      2) Siemens.
      3) ABB.

B. **Temperature Switches**

1. Features.
   a. Vapor pressure sensing with liquid filled bulb attached to bellows or diaphragm pressure element.
   b. Remote mounted bulb and capillary or local mounted bulb as shown on the Drawings.
   c. Setpoints: Field adjustable over full span of the adjustable range by means of external, tamper proof calibrated dials
   d. Contacts: SPDT, Snap action. Rated not less than 5 amperes at 120 VAC.
   e. Electrical connections: ¾-inch NPT.
   f. Bulb, Capillary, Bellows and Disc Spring Pressure Elements: Type 316 stainless steel.
   g. Diaphragm Elements: Teflon.
   h. Enclosure: Painted aluminum
   i. Provide a NEMA 4X (for non-hazardous areas) or NEMA 7 (for hazardous areas) rated enclosure.
   j. Enclosure suitable for wall or pipe stand mounting.
   k. Capillary of sufficient length to extend from process connection to switch for remote mounted bulbs.
   l. Deadband: Minimum of 1% of adjustable range span. Field adjustable on-off differential from minimum value to maximum of the full range.

2. Accessories.

   a. Type 316 Stainless Steel thermowell with ½-inch NPT process connection for both remote and local mounted bulbs.

3. Manufacturer.

a. Subject to compliance with the requirements of this specification, provide temperature switches manufactured by one of the following or approved equal:

1) Barksdale Controls.
2) Emerson/Automatic Switch Company.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions**. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. **Discrepancies.** In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. **Protection**

1. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
2. Provide blocking and cushioning materials to prevent damage during shipment.
3. Provide temporary lifting lugs on shipping package as needed.
4. Include approximately 1 pint of touch-up paint for each finish color in shipment.

B. **Surface Preparation.** The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.3 INSTALLATION

A. **General**. Coordinate the installation of ambient temperature monitor with the physical layout of the control room or electrical room in which it is installed.

3.4 FIELD QUALITY CONTROL

A. **Calibration**

1. Verify calibration on field-calibrated devices using calibrated test equipment.

B. **Tests**. Upon completion of all inspections and prior to acceptance by Owner, perform field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.5 DEMONSTRATION

A. **General**. Before required tests may be performed, the Contractor, along with a qualified representative of the instrument supplier, shall thoroughly demonstrate to the Engineer and to the Owner's personnel the operation and maintenance of all items provided under this section.

B. **Features**. Reliable and accurate operation of each temperature sensor and all specified accessories shall be demonstrated. This shall include accuracy, stability, and repeatability as specified over a range inclusive of the maximum (high alarm) and the minimum (low alarm) temperatures based on the environmental temperature range as outlined in the specifications.

3.6. SCHEDULE

A. **TEMPERATURE SENSOR**

Tag No.	**Analyzer Location**	**Mounting**	**Enclosure Type**
TSH-529	Filter Air Scour Blower #1	XXX	NEMA 4X
TSH-529	Filter Air Scour Blower #1	XXX	NEMA 4X
TSH-529	Filter Air Scour Blower #1	XXX	NEMA 4X
TI-529	Filter Air Scour Blower #1	XXX	NEMA 4X
TSH/TE-529	Filter Air Scour Blower #1	XXX	NEMA 4X
TSH-529	Filter Air Scour Blower #2	XXX	NEMA 4X
TI-535	Filter Air Scour Blower #2	XXX	NEMA 4X
TSH/TE-535	Filter Air Scour Blower #2	XXX	NEMA 4X
TT-1/2/3	High Service Pump #1	XXX	NEMA 4X
TT-1/2/3	High Service Pump #2	XXX	NEMA 4X
TT-1/2/3	High Service Pump #3	XXX	NEMA 4X
TT-1/2/3	High Service Pump #4	XXX	NEMA 4X
TT-1/2/3	High Service Pump #5	XXX	NEMA 4X

END OF SECTION

SECTION 40 93 00

PROCESS CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**. Refer to the Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional requirements related to this section.

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment, and materials necessary to install process controller.

B. **Types**. The types of equipment specified in this section include the following:

1. Proportional, integral, derivative (PID) controllers.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to process controller equipment. Provide products and components which have been UL listed and labeled.
4. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications. Firms regularly engaged in the manufacture of process controllers whose products have been in satisfactory use in similar service for at least 5 years.
2. Installer's Qualifications. Firm with at least 5 years of successful installation experience on projects with materials and equipment similar to items specified herein.

1.4 **SUBMITTALS**

A. **General**. Furnish manufacturer's product data, test reports, and materials certifications as required. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements, all of which apply.

B. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished under this section.

1.5 **JOB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Storage and Protection**. Store the items furnished under this section until they can be installed. Such storage shall meet the requirements of the manufacturer and be approved by the Owner. Use all means necessary to protect the material of this section before, during, and after installation, and to protect the installed work and materials of all other trades.

1.7 **SPECIAL WARRANTY**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **PID Controllers**

1. Features.

a. Solid-state microprocessor based.
b. Flush panel mount modular construction, 3 inches wide by 7 inches high face dimensions.

c. Direct current (dc) power supply for control loops.

d. Inputs. (Three) (Four) analog and (two) (four) discrete.

e. Outputs. Two analog and (three) (four) discrete.

f. EIA-422 data link communication.

g. Front panel, bar graph, and digital display of process variable, set point, and output.

1) Vertical bar graphs with direct reading scales for set point and process variable configured in engineering units.

2) Horizontal bar graph with scale configured in engineering units.
3) Four digit digital readout display with decimal point and minus sign.

h. Membrane front panel push button control for the following:

1) Digital display selector.
2) Remote/local set point mode selector.
3) Automatic/manual output control selector, permitting bumpless, balanceless transfer.
4) Raise/lower set point adjustments.
5) Increase/decrease manual output adjustments.

i. Indicators for the following:

1) Remote or local set point mode.
2) Automatic or manual mode of operation.
3) Process alarm.

j. Antireset wind up.

k. Ramp set point capability.

l. Output limiting.

m. Alarming (high and low process and deviation).

n. Square root extraction of process variable.

o. Ratio control.

p. Lead/lag.
q. Direct/reverse action.

r. Cascade control.

s. Proportional, integral, derivative, and manual reset tuning adjustments.

2. Sizes and Ratings.

a. Input Power. 115 Volts alternating current (Vac) ±10 percent, 60 herz (Hz).
b. Analog Inputs. 1 to 5 volts direct current (Vdc) or 4-20 milliampere (mA) dc with 250-ohm range resistor.
c. Analog Outputs. 1 to 5 Vdc and 4-20 mAdc.
d. Number of control loops as specified in the Contract Drawings.

3. Manufacturer.

a. Available manufacturers of controllers include, but are not limited to, the following:

1) ABB.
2) Foxboro.
3) Moore Products Co.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verification of Conditions**. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that it is complete such that this installation may properly commence.

B. **Discrepancies**. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. **Protection**

1. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
2. Provide blocking and cushioning materials to prevent damage during shipment.
3. Panel mounted instruments and equipment to be installed inside enclosures, panels, or consoles shall be mounted and assembled at the panel manufacturer's facility.

B. **Surface Preparation**. The work shall be carefully laid out in advance. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.3 INSTALLATION

A. **General**. Install equipment, as indicated, with manufacturer's written instructions, and with recognized industry practices.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Upon completion of this portion of the work, provide for the services of a qualified representative of the manufacturer to inspect and approve the installation.

B. **Tests**. Upon completion of all inspections and prior to acceptance by the Owner, perform the field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

3.5 **DEMONSTRATION**

A. **General**. When all required tests have been performed and prior to final approval, a qualified representative of the supplier shall thoroughly demonstrate to the Owner's personnel the operation of all items installed under this section in accordance with Section 40 90 00.

END OF SECTION

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SECTION 40 93 13

CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section. This section is a Division 26 section and is part of each Division 26 section making reference to the materials and equipment specified herein.

B. **Related Sections.** The following sections contain requirements that relate to this section:

1. Section 26 05 12 "Wires, Cables, and Connectors."
2. Section 26 05 53 "Electrical Identification."

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to install control devices in accordance with the plans and as specified herein.

1. Types of control and indicating devices in this section include the following:

a. Pilot devices.
b. Elapsed time meters.
c. Relays and timers.
d. Intrinsic barriers.
e. Sensing devices (limit switches, proximity switches, etc.).
f. Alarms and signals.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

1. Electrical Code Compliance. Comply with applicable local code requirements of the authority having jurisdiction and the National Electrical Code (NEC).
2. National Electrical Manufacturers Association (NEMA) Standard 1CS2-216, push buttons, selector switches, indicating lights, and push-button stations.

1.4 **SUBMITTALS**

A. **Transmittals**. Furnish manufacturer's product data, test reports, and material certifications as required.

1. Submit product data to include catalog cut sheets, product specifications, test reports, and material certifications on all products specified.
2. Submit product samples on all products specified.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Deliver control devices** and components properly packaged in factory fabricated type containers or wrappings which properly protect devices from damage.

B. **Store control devices** in a dry clean place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. **Handle control devices carefully** to prevent damage, breaking, and scoring. Do not install damaged equipment or components; replace with new.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **PILOT DEVICES**

A. **General**. Round, heavy duty, 30.5 millimeter (mm) NEMA rated equal to enclosure, legend plates as specified in Division 26 section "Electrical Identification."

B. **Push Buttons.** Momentary, extended head, color as shown on drawings.

C. **Emergency Stop Push Buttons.** Maintained, 2 1/4 inch mushroom head, red.

D. **Selector Switches.** Maintained, unless otherwise shown, number of positions as shown on drawings.

E. **Cylinder Lock Operator.** Push-button selector switch operable only when key in lock. Provide two keys.

F. **Contact Blocks.** Heavy duty, 10 amp continuous current rating, screw terminals, number and type of contacts as shown on drawings.

G. **Pilot Lights.** Push-to-test transformer type (120 volt primary, 6 volt secondary). Color as shown on drawings.

H. **Accessories.** Provide the following accessories where shown on drawings:

1. Protective boot.
2. Padlocking cover.
3. Lockout attachment.

I. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering pilot control devices which may be incorporated in the work include, but are not limited to, the following:

1. Allen Bradley Co.
2. Cutler Hammer.
3. Micro Switch.
4. Square D Company.

2.2 ELAPSED TIME METERS

A. **General.** 120 volt, synchronous motor driven, mechanical register indicating up to 99,999.9 hours.

B. **Window Kit.** Type 304 stainless steel frame, brushed finish, polycarbonate window, oil resistant gasket, NEMA 4X.

2.3 RELAYS AND TIMERS

A. **General Purpose Relays.** General purpose, plug-in, tube base, transparent polycarbonate housing, 3PDT, 10 amp contact rating, coil voltage as shown on drawings.

B. **General Purpose Timing Relays.** General purpose, plug-in, tube base, solid state, 2PDT, 10 amp contacts. Voltage rating, timing range, and timing mode (on delay/off delay) as shown on the drawings.

C. **Heavy Duty Relays.** 600 volt industrial control relay, convertible contacts rated for 10 amps continuous, coil voltage and quantity and type of contacts as shown on drawings.

D. **Heavy Duty Timing Relays.** 600 volt industrial control relay as specified above with solid state timing attachments. Coil voltage, timing range, timing mode (on delay/off delay), and quantity and type of contacts as shown on drawings.

E. **Mounting Sockets.** Eight or 11 pin surface mounted relay socket for tube base relays, screw terminals, with hold down clamp.

F. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering relays and timers which may be incorporated in the work include, but are not limited to, the following:

1. Allen Bradley Co.
2. Potter & Brumfield, Inc.

3. Square D Co.
4. SSAC Inc.
5. Time Mark Corp.
6. Cutler Hammer

2.4 INTRINSIC BARRIERS

A. **General.** Intrinsically safe, contact closure input, triac output, rail mounted, FM approved, 120 volt supply, intrinsically safe ground not required.

B. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering intrinsic barriers which may be incorporated in the work include, but are not limited to, the following:

1. Pepperel & Fuchs Inc.
2. Or equal

2.5 SENSING DEVICES

A. **Limit Switches.** NEMA 4X, four operating head mounting positions, DPDT contacts (side rotary) (side push) (top push) (wobble) operating head, (maintained) (momentary) contacts, stainless steel (roller) (adjustable rod) operating lever.

B. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering sensing devices which may be incorporated in the work include, but are not limited to, the following:

1. Allen Bradley Co.
2. Cutler Hammer.
3. General Electric.
4. Microswitch.
5. Square D Co.

2.6 ALARMS AND SIGNALS

A. **Horns.** Vibrating diaphragm horn, 120 volts alternating current (Vac), (weatherproof mounting box) sound output of 100 decibels (dB) at 10 feet.

B. **Warning Lights.** Rotating sealed beam incandescent lamp, (100 watt) (200 watt) cast aluminum housing, (lexan) (glass) dome, color as shown on plans, 120 Vac.

C. **Strobe Light.** High intensity strobe, self-contained power supply, cast aluminum housing, lexan dome, color as shown on plans, 120 Vac.

D. **Available Manufacturers.** Subject to compliance with requirements, manufacturers offering alarms and signals which may be incorporated in the work include, but are not limited to, the following:

1. Federal Signal Corp.

2. Or equal

PART 3 - EXECUTION

3.1 INSTALLATION OF CONTROL DEVICES

A. **Installation**. Install control and indicating devices as indicated in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's (NECA) "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

1. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of control and indicating devices with other work.
2. Install control and indicating devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
3. Install control and indicating devices after wiring work is completed.
4. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for control and indicating devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in Underwriters' Laboratories, Inc. (UL) Standards 486A and 486B. Use properly scaled torque indicating hand tool.
5. Install control and indicating devices in enclosures as required under other sections and as shown on the drawings.

3.2 GROUNDING

A. **General.** Provide equipment grounding connections for control and indicating devices, unless otherwise indicated. Tighten connection to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

3.3 TESTING

A. **General.** Prior to energizing circuitry, test control stations for electrical continuity. Subsequent to completion, demonstrate capability and compliance with project requirements.

END OF SECTION

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SECTION 40 95 13

CONTROL PANELS AND CONSOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

B. **Related Sections**

1. Section 40 90 00, "Instrumentation Systems Basic Requirements."
2. Section 26 05 12, "Wires, Cables, and Connectors."
3. Section 26 05 23, "Communication and Signal Cables."
4. Section 26 05 34, "Cabinets, Boxes, and Fittings."
5. Section 26 27 26, "Wiring Devices."
6. Section 26 05 53, "Electrical Identification."
7. Section 26 05 26, "Grounding."
8. Section 26 28 00, "Overcurrent Protective Devices."
9. Section 26 29 00, "Motor Controllers."
10. Section 26 56 71, "Luminaires."
11. Section 40 93 13, "Control Devices."

1.2 DESCRIPTION OF WORK

A. **General**. The Contractor shall provide the labor, tools, equipment, and materials necessary to install control panels and consoles in accordance with the plans and as specified herein.

1.3 QUALITY ASSURANCE

A. **Regulatory Requirements**. Comply with requirements of the National Electrical Code (NEC) and all other applicable federal, state, and local codes and regulatory requirements.

B. **Standards**. Materials and workmanship shall conform to the following standards:

1. National Electrical Manufacturers Association (NEMA).
2. Institute of Electrical and Electronic Engineers (IEEE).
3. American National Standards Institute (ANSI).
4. National Fire Protection Association (NFPA).
5. Underwriters' Laboratories (UL).
6. Joint Industrial Council (JIC).
7. International Society for Measurement and Control (ISA).

B. **Qualifications**

8. Manufacturer's Qualifications. Firms regularly engaged in the manufacture of control panels whose products have been in satisfactory use in similar service for not less than 5 years.
9. Installer's Qualifications. Firm with at least 5 years of successful installation experience on projects with materials and equipment similar to items specified herein.

1.4 SUBMITTALS

A. **General**. Furnish manufacturer's product data for enclosures and all components.

B. **Materials List**. Submit a bill of materials listing quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished or installed under this section.

1. Elementary diagrams shall follow JIC standards.
2. Instrument loop diagrams shall follow the ISA Standard S5.4.
3. Wire, terminal, and component labeling shall follow established facility conventions where applicable.

D. **Shop Drawings**. Provide control panel layout drawings which follow JIC standards. Provide shop drawings for each control panel and console as follows:

1. Dimensional drawings of each enclosure and mounting panel.
2. Scaled layout drawings identifying name and location of all components and nameplates.
3. Mounting details including location of anchoring flanges, holes, and data on anchor bolt sizing and load-carrying capacity.
4. Entry and exit locations of external wiring and conduit and equipment connections.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Storage and Protection**. The Contractor shall store the items furnished under this section until they can be installed. Such storage shall meet the requirements of the manufacturer and be approved by the Owner. Use all means necessary to protect the material of this section before, during, and after installation, and to protect the installed work and materials of all other trades.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 ENCLOSURES

A. **Hinged Door Enclosures**. As specified in Section 26 05 34, "Cabinets, Boxes, and Fittings," and as shown on the plans.

2.2 COMPONENTS

A. As shown on the plans and in specifications

B. **Miscellaneous Equipment**

1. Slotted plastic wiring ducts with snap-on covers.
2. Nylon spiral wrap wiring sheaths.
3. Nylon cable ties with screw anchors.
4. Nameplates as specified in Section 26 05 53, "Electrical Identification," and as shown on the plans.
5. Stainless steel screws, fasteners, and miscellaneous hardware unless otherwise noted.

2.3 SHOP FABRICATION

A. **General**

1. Fully assemble and test each panel at the factory prior to shipment.
2. Provide 20 percent spare mounting space and 20 percent spare terminals for future expansion.
3. Identify all components with laminated plastic nameplates.
4. Provide a fluorescent light and switch in all panels greater than 8 inches deep and in all exterior panels.
5. Provide a NEMA 5-20R receptacle in each panel.

B. **Component Arrangement**

1. Group all like components.
2. Place all internal components on subpanels.
3. Arrange all components to allow easy access for connections and service, and to allow removal without affecting other components.
4. Place all indicators, recorders, and controllers between 48 inches and 68 inches above the finished floor.
5. Place all pilot devices at least 30 inches above the finished floor.
6. Arrange front of panel devices as shown on the plans.

C. **Component Installation**

1. Make all panel cutouts carefully and leave no visible gaps between components and panels.
2. Provide a sealing gasket between the panel and components at all cutouts in NEMA 4 or 4X panels.
3. Mount all components plumb and square.
4. Attach all components and nameplates with stainless steel machine screws into drilled and tapped holes.
5. Support and restrain all components to prevent movement.
6. Attach all relays to mounting strips or rails.

D. **Wiring**

1. Route wiring horizontally or vertically.
2. Protect wiring to door-mounted devices with spiral nylon sheath.
3. Separate alternating current (ac) and direct current (dc) wiring a minimum of 4 inches.
4. Label all wires at each termination with a unique number.
5. Label each terminal with a unique number.
6. Terminate all external wiring on terminal blocks.
7. Terminate all internal wiring on terminal blocks or device terminals.
8. Group all externally powered wiring and terminate on knife disconnect isolating terminal blocks.
9. Terminate all wiring to devices powered from the control panel on fused terminal blocks.
10. Color code all internal wiring as follows:
    a. Line Voltage ac Power and Control. Black.
    b. ac Control Circuits (less than 50 volts). Red.
    c. dc Wiring. Blue (positive), brown (negative).
    d. Externally Powered Wiring. Yellow.
    e. Neutral Conductors. White.
    f. Equipment Grounding Conductors. Green.
11. Route all wiring on subpanels through plastic wiring ducts with removable covers.
12. Support all wiring to prevent movement or sagging.
13. Secure all cable ties with bolted or screwed mounting plates.
14. Provide a warning sign, placed in a conspicuous location in the interior of the panel, identifying yellow wiring as being powered from an external source and warning that disconnecting power to the panel will not de-energize externally powered wiring.

E. **Panel Grounding**

1. Provide ground studs factory welded to the enclosure and the enclosure door. Provide tinned copper braided ground strap between enclosure and door.
2. Provide a minimum No. 8 American Wire Gauge (AWG) ground wire from subpanel to enclosure mounting stud.

3. Ground control power transformer secondary directly to subpanel immediately adjacent to transformer.
4. Where signal cable shields are to be grounded in the control panel, connect to the equipment ground bus.
5. Connect all dc commons to the low level isolated dc ground bus.

PART 3 - EXECUTION

3.1 **INSTALLATION**. Install equipment as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices.

A. **Examination**

1. Verification of Conditions. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Discrepancies. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

B. **Preparation**

1. Protection.

   a. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.
   b. Provide blocking and cushioning materials to prevent damage during shipment.
   c. Provide temporary lifting lugs on shipping package as needed.
   d. Include approximately 1 pint of touch-up paint for each finish color in shipment.

2. Surface Preparation. The work shall be carefully laid out in advance. Where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary, this work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

C. **Application**

1. Enclosure, Cabinets, Console Installation.

   a. Locate as shown on the contract drawings. Freestanding enclosures and consoles require a 4 inch concrete pad provided and installed by this Contractor.
   b. Floor-mounted control panels shall be installed utilizing all stainless steel hardware consisting of concrete anchor and machine bolt assembly.

c. Wall-mounted panels shall be offset from walls with standoffs. Wall-mounted panels requiring freestanding mounting shall be supported on stainless steel strut with cross bracing and stainless steel hardware.

d. Seal all conduit entrances watertight.

3.2 FIELD QUALITY CONTROL

A. **Tests.** Upon completion of all inspections and prior to acceptance by the Owner, perform the field tests outlined in Section 40 90 00, "Instrumentation Systems Basic Requirements."

B. **Inspection**. Upon completion of this portion of the work, the Contractor shall provide for the services of a qualified representative of the manufacturer to inspect and approve the installation.

3.3 **DEMONSTRATION**. When all required tests have been performed and prior to final acceptance, the Contractor shall perform a 30 day Operational Demonstration in accordance with the requirements of Section 40 90 00.

END OF SECTION

SECTION 40 95 33

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM (SCADA) UPGRADE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

B. **Related Sections**. The following sections contain requirements that relate to this section.

1. Division 26 “Electrical”
2. Division 40 “Process Integration”
3. Division 43 through 46

1.2 DESCRIPTION OF WORK

A. **Furnishing supervisory control** and data acquisition (SCADA) system, instrumentation, accessories, and equipment for municipal water system. The SCADA shall include but not limited to the following:

1. At the Sugar Creek Water Treatment Plant (WTP):

a. Relocation of existing SCADA workstations, printers, network communication equipment, conduit, communications, power, and fiber optic cables to construct temporary Control Room in the first floor Storage Room 104 during construction of second floor improvements when the SCADA system can be relocated into the newly refurbished control room. The existing relocated SCADA system shall be removed after the new SCADA system is installed and fully operational.

b. Upgrading six (6) existing filter control consoles including new programmable logic controllers (PLCs), human machine interface (HMI) panels, UPS units, power supplies devices, communication, and peripherals as specified herein and shown on the Contract Drawings.

c. New Electrical Room PLC, Fluoride Room PLC, West Aerator and East Aerator Building PLCs as specified herein and shown on the Contract Drawings.

d. New large liquid-crystal display (LCD) panel for Main Control Room

e. New network rack storage units to be installed in Control Room.

f. New PLC based, fiber optic (FO) linked remote terminal units (RTUs) complete with operator interface terminal (OIT) and software for remote wells 1-10 as specified herein and shown on the Contract Drawings.

g. New SCADA workstation computers, rack mounted servers, network switches complete with software and peripherals.

h. New local area network including fiber optic links.

i. New computer console desks, office chair

j. Upgrading the existing HMI FactoryTalk software and utility software license keys including new software licenses complete with data base reconfiguration.

k. Interfacing between the new and existing control systems as shown on the drawings and specified herein.

l. Interfacing to the existing City-Wide SCADA system over high-speed internet.

m. New instrumentation as shown on the Contract Drawings and specified herein.

n. Refer to the Contract Drawings for complete system requirements.

o. Installation of new Video Server in Control Room, and integration of CCTV system with SCADA system workstations. The fiberoptic network between the RTUs, PLCs and the network cabinet shall be utilized to allow communication between the vendor supplied camera and the vendor supplied security control panel as required.

p. Integration of new I/O for Fuel Storage Control system with SCADA system.

q. Integration of new I/O for Power Distribution Equipment with SCADA system.

r. Integration of new I/O for ATI Filter Backwash Monitoring System with SCADA system.

2. Refer to Part 2 “Products” and the drawings for complete hardware and software requirements.

B. **Installation**: Ship the SCADA fully assembled, wired, and tested sub-systems complete with software and data base configuration. Install the instrumentation’s, subsystems, and interconnecting cables.

C. **Complete integration** between the SCADA computers and PLCs provided under this section and process computers and PLCs provided by other process equipment vendors as shown on the drawings.

D. **Operator** training.

E. The existing City wide water distribution SCADA including the Sugarcreek WTP SCADA system were furnished and installed by Dublin Tech Systems of Dublin, OH whom also is providing maintenance services for the current systems. It is the intent of this specification for the contractors to retain the services of Dublin Tech Systems and carry them in the base bid to furnish, install and program the new SCADA system including the servers, PCs, PLCs, RTUs, HMI panels, OITs, network equipment, fiber optic communication equipment, peripheral, software and database configuration for overall control and monitoring functions as shown on the drawings and specified herein. Refer to paragraphs 3.5 and 3.6 for pre-approved system integrators alternate bids.

F.

1.3 GENERAL REQUIREMENTS

A. **The Contractor's attention is** directed to the fact that the supervisory control and data acquisition (SCADA) system and instrumentation is an integrated system and as such shall be furnished by one (1) vendor, who will provide all the equipment and appurtenances specified under this section, regardless of manufacturer, and accept responsibility for satisfactory operation of that system. An input/output (I/O) listing of all digital and analog signals at the facility is shown on the instrumentation drawings, which shall be integrated as part of the complete control system.

B. **No system shall** be considered for approval or accepted which does not wholly fulfill the intent and requirements of the functional description, hardware, and software system as specified. Acceptance of an equal system must be by written acceptance of the Engineer. The Engineer reserves the right to request a full demonstration of any hardware, software, or other products which are submitted as approved equals prior to approval.

C. **The computer's function is that** of a control and data acquisition system. However, it must be designed with flexibility to accommodate field changes and commissioned in accordance with this specification. Documentation drawings and spare parts shall be provided. The Contractor shall also provide in-plant training as described in Section 40 90 00. Training shall be included in the bid for the SCADA system.

D. **The Specifications and Drawings** outline certain characteristics of the monitoring and control system but do not set forth all the details of system design and the various functions and equipment required. All equipment shall be complete with all necessary software, accessories, and appurtenances required for a properly operating system including all items recommended by respective manufacturers and not herein specified.

E. **The Contractor shall assume** complete system responsibility through the system integrator and provide all necessary coordination with all subcontractors.

F. **The Contractor shall coordinate** the work of the system integrator for the installation, interconnection, testing, and calibration of the instruments, and the scheduling of the system integrator's personnel. The system integrator shall also be responsible for assuring himself that this equipment properly meets the functional intent of the Contract Documents. Substitutions on functions specified are not acceptable.

G. **The system integrator shall** provide the services of an experienced Project Manager as the overall coordinator during the project. The supplier shall describe in detail the project management provided to the satisfaction of the Engineer. The Project Manager shall provide a resume of similar type of project experience upon request.

H. **The system integrator shall be required** to demonstrate a minimum of ten (10) years recent, experience in the design, integration, and commissioning of SCADA, instrumentation, and control system, including at least five (5) projects of comparable size, type, and complexity to the proposed project. The system integrator supplier shall submit to the Owner, a copy of his qualifications and a Quality Assurance Manual for review. The manual shall include, but not be limited to, a listing of recent completed projects as described above.

I. **The system integrator shall have** capable personnel for detail engineering, coordination, drafting, procurement and expediting, scheduling construction, testing, inspection, installation, start-up service for calibration and commissioning, and warranty compliance for the period specified in Contract Documents.

1. The Owner upon written notice of at least one week's time may arrange to visit the system integrator's facility to review the progress of the project.

2. The System Integrator shall perform a single Factory Acceptance Test of all PLC panels and HMI equipment in the shop, prior to shipment to the project site.

a. The System Integrator shall simulate each I/O point and with switches and signals to demonstrate that the control logic is functioning properly, and that all points are being displayed correctly in the HMI graphical displays. All help screens, trend displays, alarm screens, alarm logs, and reports shall be configured and tested for completeness and accuracy prior to scheduling the Factory Acceptance Test (FAT).

b. A test plan shall be submitted, one (1) month prior to the test, for review and approval by the Owner. Any comments or corrections shall be incorporated into the final test plan procedures and forms and resubmitted one week prior to the FAT. The Owner or Engineer will witness a full Factory Test of the software and hardware, and deficiencies shall be noted. All deficiencies shall be corrected prior to release and shipment of equipment to the jobsite.

1.4 EXCEPTIONS AND ALTERNATIVES

A. **The manufacturer shall** offer a system in accordance with this specification. No exceptions written or implied will be made and the vendor shall be capable of meeting this specification as written.

B. **Should any of the specified** manufacturers offer alternatives, equipment, or materials, he shall do so in accordance with the specifications, provide shop drawing for approval, and list each alternative separately defining the advantages of the alternative and the impact on the overall system configuration. The manufacturer shall provide proof that the use of alternatives would improve control system performance and reduce operating and maintenance costs.

C. **Where alternates are approved** by the Owner and executed, the Contractor will be held responsible for all structural, mechanical, and electrical changes required for the installation of substituted items at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with the plans and as specified herein.

1. National Electrical Manufacturers Association (NEMA) Compliance.

2. National Electric Code (NEC) Compliance.

3. Instrument Society of America (ISA).

4. Institute of Electrical and Electronic Engineers IEEE).

5. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to process controller equipment. Provide products and components which have been UL listed and labeled.

1.6 GUARANTEE

A. **The complete system shall be** guaranteed to meet or exceed the design and performance requirements of the specifications and the drawings.

B. **Equipment, software, and materials** which do not achieve design requirements after installation shall be replaced or modified by the Contractor to attain compliance, at no additional cost to the Owner.

C. **All equipment warranties shall** be guaranteed for twelve (12) months from date of Final Acceptance.

1.7 EXPANDABILITY

A. **The system proposed shall** be configurable to provide for minor changes and additions during manufacturing, installation, and commissioning phases, and on-site by the Owner's operating personnel.

B. **The system software shall** be reconfigurable in the field. The SCADA system shall be reconfigurable using computer keyboard and fill-in-the-blanks technique. Systems requiring factory assistance or an off-site computer for reconfiguration are not acceptable.

1.8 SUBMITTALS

A. **Submit shop drawings** in accordance with Specification Section 01 33 00, “Submittals”.

B. **Complete instrument and control system block diagrams**, showing in schematic form, the interconnections between major hardware components. The block diagram shall reflect the total integration of all digital and analog devices in the system. The diagram shall reference all interconnecting cabling requirements for digital components of the system including any data communications links.

C. **All significant equipment** to be supplied shall be listed followed by descriptive data sheets. The equipment list shall include, but not limited to, each component name, manufacturer, model number, a description of the operation, quantity supplied, and any special setup and operation and maintenance characteristics.

D. **Drawings of equipment** to be supplied shall include, at a minimum, overall dimensional details for each unit including installation arrangements and door mounted operator devices including nameplate designations. Wiring diagrams of all PLC and other system equipment including field device connections and specific installation wiring responsibilities identified.

E. **Input/output drawings** shall indicate terminal numbers and signal identification name.

F. **Arrange**, identify, and bind all submittals complete with suitable index.

G. **Process Control Description Updates for Record Documents** shall include all revised and updated process control descriptions following any PCS workshops, working sessions, and/or related submittal reviews, and updated continuously

during programming, start-up and testing to reflect all refinements and changes that occur due to specific operational needs and the characteristics of specified equipment and systems supplied under this Contract.

H. **Software submittals shall** provide a complete description of the system on a functional level. It is not the intent of this documentation to describe the individual programs.

I. **The software submittal shall** cover the detailed control algorithms, plant reports, and process graphic displays that the system supplier has developed through meetings with the Engineer and the Owner.

J. **Prior to the software submittal**, the software supplier shall meet with the Engineer and the Owner to review/modify function of all operations to tailor the software to this specific application. Specifically, at a minimum, this shall include the configuration of all displays, graphics, and operator interfacing. The function of all software process control and loops shall also be included. This process shall be repeated after the factory demonstration. The total time estimated for this work is one (1) eight (8) hour day. Travel and subsistence for software supplier shall be included in the bid for the SCADA system.

1.9 TESTING AND TRAINING REQUIREMENTS

A. Fabrication Testing

1. Major subsystems shall be individually tested for function and operation in a staging area in the Integrator's facility. The subsystems shall be interconnected as they will be installed in the treatment facility, and testing shall be performed using simulated inputs and outputs to assure subsystem function and compatibility. The Integrator shall furnish a certified copy of the results on each subsystem, indicating model and serial numbers, tests performed, and status of equipment after testing.

B. Job Site Demonstration

1. Following final installation and calibration of the system, the Integrator shall perform a demonstration of system performance. Satisfactory performance shall require the system to perform control functions, monitoring and display functions, alarming, and printout functions for a period of not less than one (1) month of continuous operation. During this demonstration, any system failure or software-related problem(s) shall be corrected, and the demonstration resumed. Acceptance of the control system by the Owner shall require that the system operates continuously for a period of one (1) month without non-field or field repairable hardware or software interruption. Substantial completion shall not be awarded until after the Contractor has successfully completed the required tests specified herein, all O&M documentation has been submitted, all Owner's staff training programs have been completed, all as-built documentation, and spare have been provided.

C. Training

1. The Integrator shall include at the site, operator and maintenance training for the facility's personnel as described in Section 40 90 00 and Contract Documents.

D. System Calibration and Start-up

1. The vendor shall provide the initial calibration and start-up of the control system by providing factory-trained personnel to perform the following:

    a. Supervise the installation and verify the final connections of all signal and power wiring to and from the control system.

    b. Perform all hardware calibration and diagnostic tests and make all necessary equipment connections.

    c. Perform all configuration system tests, including diagnostics.

    d. Perform the system acceptance test as described in the "Job Site Demonstration" section of this specification.

    e. Test the operation of the Communications Control System and Input/Output Subsystem.

    f. Verify the displays and functions of the control System at workstation computer and PLC's.

1.10 OPERATION AND MAINTENANCE MANUALS

A. **The Contractor shall** furnish via the System Integrator, clear, typewritten, easy-to-understand, tightly bound, hard cover instruction manuals for daily operation and maintenance of the system. Specifically, the manuals shall contain explicit instructions and well-diagramed procedures for process operations, loop tuning, and systems maintenance. The instruction manuals shall include as a minimum the following information.

1. Photographs and data sheets of major system components.

2. Input/Output terminal diagrams.

3. Logic and block diagrams.

4. Manufacturer-published operation and maintenance instructions on all equipment.

5. Description of systems operation.

6. Configuration language description.

7. Names, addresses, and telephone numbers of local equipment manufacturer representatives for each device in the system.

8. Listing of expendable materials by form, stock, or model number (e.g., paper, magnetic discs, ribbons, etc.).

B. **Manual**: Provide two (2) USB Flash Drives and two (2) hard copies of the manual for use by system operators and shall include as a minimum:

1. A simple pictorial presentation and description of the system.

2. A functional description of all operator interfaces at all levels of control should be described.

3. A description of each type of data format.

4. A description for each of the operator controls, its task, and method of recognizing a response to operator manipulation. This description shall include all buttons and keyboards.

5. A glossary of terms with all acronyms spelled out.

6. Separate step-by-step procedure shall be provided for each action to be performed in operating the system. These procedures should include, but not be limited to, the following:

   a. Start/stop operation.

   b. Emergency procedures.

   c. Controls mode changes.

   d. All software housekeeping or caretaking operations changing date and time, point calibration, point activation, point deactivation, tuning parameter, and setpoint changes.

   e. Software procedures that are beneficial to the operator to determine that the system is functioning properly.

   f. Procedures for changing paper, tape, and other housekeeping operations.

7. These manuals shall be separately bound and shall contain all information required by the system operator to perform all functions related to this project. Manuals shall be available at the time of the operator's training course and shall be covered as part of the course material.

8. The system operator’s manual shall include all SCADA screen and sub-screen shots in color each followed by monitoring and controls functional description for each piece of equipment and instrument that are being controlled or monitored from the SCADA system. These manuals shall be similar in terms of format and orientation to those prepared for the Northeast WTP and Northwest WTP. These manuals will be required during the operator training sessions.

C. **Electronic Documentation:** Provide all final “as-built” application programs, PLC ladder logic diagrams complete with documentation, HMI screen and SCADA data base on two (2) USB Flash Drives with one (1) serving as a duplicate of the first.

1.11 MAINTENANCE MATERIALS

A. **The manufacturer's recommended** spare parts shall be supplied with the system along with the following items if they are not part of the recommended spares.

1. One (1) central processor module capable of replacing any CPU throughout the system excluding the workstation computers.

2. One (1) spare I/O module for each type of digital input, digital output, analog input, and analog output used within the system.

3. One (1) year's supply of printer paper.

4. One (1) year's supply of all replaceable ink cartridges.

5. Ten (10) fuses of each type used by the system.

6. Ten (10) indicating lamps used at panels.

7. One (1) OIT for each type used within the system.

8. One (1) fiber optic module, media converter for each type used within the system.

9. One (1) Ethernet switch for each type used within the system.
10. One (1) power supply for each type used within the system.
11. One (1) router for each type used within the system.
12. One (1) UPS of each type used within the system.
13. One (1) HMI panel for each type used within the system.

1.12 FUNCTIONAL DESCRIPTION - GENERAL

A. **The Supervisory Control and Data Acquisition** (SCADA) system shall monitor and control the operations of Sugar Creek WTP and the Wellfield Wells 1-10 and shall communicate with the City-Wide SCADA system including the surge tanks, water storage facilities, water booster pump stations, Northwest WTP, Northeast WTP, and pressure monitoring stations over high-speed internet as indicated on the Contract Drawings.

B. **The SCADA** shall be configured to maximize flexibility in operation of the pumps. Multiple adjustable setpoints shall permit combinations of pump sequences varying from each pump operating at a separate setpoint to all the pumps operating at a single setpoint. In the case where more than one pump is controlled by the same setpoint, adjustable time delays shall be provided in software to prevent pumps from starting or stopping at the same time, which could result in damaging hydraulic surges and transient pressures.

C. **Adjustment** of the pump setpoints, pump on/off control or operating sequences for all pumps shall be possible from the SCADA computers and the operator interface terminals.

D. **As a potential energy** cost saving feature, the pumps shall be capable of operation on time-of-day control basis for off-peak operation of the pumps. Also, to prevent exceeding the established capacity of each water supply source, an adjustable run timer shall be provided in the software for each pump to limit the time per day that the pump is allowed to operate. These functions shall be selected via software selector switches.

E. **Automatic** overriding of the peak power period timers for all the pumps shall be possible by an adjustable setpoint (i.e., tank low level alarm, etc.) during times when it is not desirable to wait until off-peak times to refill the storage tank.

F. **After a preset** time delay, should the actual pump status disagree with “called” status, the pump fail alarm shall be activated.

G. **The treatment process at the Sugar Creek Water Treatment plant** shall be divided into sub-systems and shall be controlled by stand-alone PLC’s dedicated to each local process, totally independent from the SCADA computers. The SCADA central computers and PLC’s shall be networked together over fiber optic medium, utilizing Ethernet protocol for control, monitoring and data acquisition functions. It is the responsibility of the system integrator to provide complete and fully operational integration between all PLC’s within the facility for plant control and monitoring functions. All application programs for local process shall be configured and reside on the local PLC’s processes and not at any workstation computers. The operators shall be able to control, monitor, and view the process graphics for any filter within the facility from any workstation computer or from any PLC panel or filter console’s HMI as required.

H. **Process variables, equipment status** and alarm information shall be gathered from the Sugar Creek water treatment facility and distribution system. Any changes to PLC's application programs, set point changes, override functions, alarm acknowledgment, etc. shall be possible from the local HMI/OIT or any SCADA computer over the communications medium.

I. **Adjustments** of the process variables, pump setpoints, pump on/off control or operating sequences for all pumps, valves, and related process shall be possible from either the SCADA computer or the PLC via the local HMI panel or the local operator interface terminal.

J. **Process variables, equipment status** and alarm information shall be gathered from the WTP and remote pump stations. Any changes to PLC's application programs, set point changes, override functions, alarm acknowledgment, etc. shall be possible from the local HMI/OIT or any SCADA computer over the communications medium.

K. **Adjustments** of the process variables, pump setpoints, pump on/off control or operating sequences for all pumps, blowers, valves, and related process shall be possible from either the SCADA computer or the PLC via the local HMI or local operator interface terminal.

L. **The SCADA** servers and workstation computer HMIs shall allow the operators to perform data acquisition functions such as report generation, alarm management, trending, graphic presentation of process in real-time basis and control functions such as equipment on/off, set point changes on process variables, etc. The servers and computer shall also allow the override functions of control blocks upon the operator's command. Failure of the SCADA servers and computers shall not interrupt the operation of SCADA system in performing control and monitoring functions. New software will be provided for the two (2) SCADA Servers to be installed at the Sugar Creek WTP Control Room on the second floor of the Main Building. The two (2) new servers shall be node 1 and 2 at Sugar Creek WTP shall be configured with fully automatic redundancy through the network. Two (2) servers and two (2) workstation computers each pair shall run in parallel, executing and storing all the data received over the network for complete controls and monitoring functions. Upon failure of any server/computer, the remaining server/computer shall automatically continue to perform the SCADA tasks.

M. **The SCADA** system shall allow the plant personnel to monitor all associated processes and to change setpoints as required. It shall also provide status conditions, alarm conditions, display of trend and selected loop display. The system shall perform totalizing the recording functions of selected process variables.

N. **The system** shall have the capability of storing all process variables and shall provide either daily, weekly, or monthly printouts as selected by the operator. Status conditions display of trends and selected loop display shall be provided.

O. **In addition to communication with local PLC's**, the new SCADA workstation computers shall be networked with the SCADA computers at Northwest WTP and Northeast WTP facilities over high-speed internet service using cable service Digital Subscriber Line (DSL), as shown on the Contract Drawings. The DSL router will be relocated to the first floor Filter Gallery Annex and re-routed to the SCADA Control Room IT Closet on the second floor of the Main Building where it will be reconnected to SCADA systems provided under this contract.

P. **The system** shall include software audible and selectable dialer alarm. In the event an alarm is not acknowledged at the control stations, the pager software will be activated. The system first calls a pager if no alarm acknowledgment is obtained, then the SCADA software dialer after pre-set time delay will call a series of numbers giving a verbal message of the alarm utilizing the software dialer. The paging software shall be provided on SCADA primary computer (for plant process and well field alarms).

Q. **The SCADA** system shall be able to monitor the current plant operations using graphic process screens in a "Read-only" format over the Internet. This capability shall be accomplished using a standard Internet browser such as Internet Explorer. Only authorized users shall be able to access the plant information using the built-in browser security features and the SCADA system firewalls. This "live" plant-wide browsing functionality shall sit outside/above the plant's main SCADA system thereby providing total "lock-out" to vital plant operation functions such as setpoint changes and toggling of pumps or valves for AUTO/MANUAL/ON/OFF/OPEN/CLOSE.

R. **The system** shall provide for:

1. Data gathering of analog and digital real time process signals and manual laboratory inputs. Constants and coefficients for calculations to be performed must be entered manually.

2. Logging of water treatment and distribution system performance which includes accumulation of data such as flow, level, pH, turbidity, chlorine, etc., averaging maximum and minimum outputs for "on demand," daily and monthly logs. Logs shall include plant efficiency data and indices as well as reports for official use to regulatory agencies.

3. Equipment maintenance programs consisting of separate logs, listing services required upon reaching the programmed hours of running for a motor or other piece of equipment.

4. Interactive graphic displays to schematically represent the plant process and pumping stations.

S. **A new CCTV security system** shall be furnished per Section 28 16 00 and installed to provide monitoring of remote well, main gate, areas surrounding the Main Building, and four interior locations in the WTP building using remotely controlled CCTV cameras to locally store, capture events, and provide live feed management between the host video control center and the remote video camera and controller. The installation shall be integrated with the SCADA system to allow security events detected in the SCADA system to trigger capture of video data and provide operator notification in a window or alarm viewing panel in the SCADA system.

1.13 FUNCTIONAL DESCRIPTION – APPLICATION PROGRAMS:

A. PLC No. 1 through 6 (Filter consoles at Sugar Creek WTP):

1. Filter Level:

a. The level signal shall be transmitted to the SCADA from the new level transmitter located at the filter unit. The SCADA shall tabulate and store the daily minimum, maximum and average level. The level signal in conjunction with the filter effluent signal shall control the rate of flow through the filter.

b. Electronic trips shall be capable of being redefined with software commands, shall be provided as follows:

1) High Level: High Level Alarm (Filter Influent Control Valve close and all well pumps called to stop).

2) Low Level: Low Level Alarm. (Filter effluent valve close.). Note that: Low level alarm shall be disabled during backwash and drain cycle. This

2. Filter Influent Control Valve

a. The filter influent modulating valves shall be controlled from the SCADA based filter level, backwashing cycle, influent flume level, or as selected by the operator. There is one (1) Filter Influent Control Valve per Filter that feeds two filter cells connected by a common center flume.

1) Filter Level Control. Control based on filter level which shall close automatically if the high-level alarm is active in the filter.

2) Backwashing Cycle. See description provided below for details.

3) Influent Flume Level. Control based on the Influent Distribution Box level control based on the low-low level alarm.

3. Filter Effluent Control Valve:

a. The filter effluent modulating valves shall be controlled from the SCADA based on filter level, filter flow, percent valve open via a software PID loop, backwashing cycle, or as selected by the operator. There is one (1) Filter Effluent Control Valve per Filter Cell for a total of two (2) per Filter.

1) Filter Level Control. Control based on filter level control shall utilize the below formula. Note that the flow rate through the filter fluctuates to maintain a constant level. Each online filter is trying to filter the same amount of water.

2) $$\boldsymbol{Flow\ Setpoint = 2\ MGD\ X \left(\frac{Current\ Level - LLS}{HLS - LLS}\right)}$$

a) LLS: Low level setpoint as described under the Filter Level Section above.

b) HLS: High level setpoint as described under the Filter Level Section above.

3) Filter Flow Control. Control based upon filter flow control maintains a constant flow rate matching the MGD input by the operator. This filter will run at that setpoint, regardless of the filter level or the settings of the other filters.

4) Percent valve open control. The filter effluent valve will maintain a constant position inputted by the operator. The filter flow rate will depend on how much the Filter

Effluent Control Valve is open. This filter will run at that valve setpoint, regardless of the filter level or the settings of the other filters.

5) Backwashing Cycle. See description provided below for details.

4. Backwash Flow Meter on Backwash Pump Discharge (FE710)

a. The operator shall select the source of backwash water, either the backwash pump or by gravity flow from existing auxiliary Makeup Reservoir. (FE531. If the operator selects Backwash Pump, the variable speed backwash pump starts and after a time delay, the backwash flow control valve will open until backwash flow reaches the set point rate. rates set in the SCADA program. A Modulated flow Control valve FCV766 will modulate in Auto to maintain the flow rate required by the Backwash Program. At each filter console, the operator shall select if the backwash pump or the Makeup Reservoir is being used for backwashing the filter, and the SCADA program will control the appropriate valves to execute the backwash sequence.

b. In Manual, the Backwash Pump speed is set, and the flow rate can be controlled using the Flow Control Valve and the magnetic flow meter reading.

c. The flow signal from shall be transmitted to the SCADA from the new magnetic flow meter located in the discharge line of backwash pump.

d. The SCADA system shall totalize the flow on a daily, weekly, monthly, and to-date base; and shall tabulate and store daily average and maximum flows.

e. The SCADA system shall output an analog signal to the backwash water modulating valve controller to maintain a desired flow rate during backwash cycle via a software PID loop.

f. A software selector switch including the valve open/close target position shall be provided to allow the operator to modulate the valve manually or automatically through the software PID loop. In addition, the SCADA shall receive the valve position status for indication and monitoring functions.

g. A pressure transmitter located on the discharge line of the Backwash Pump will transmit a signal to SCADA system. If there is not pressure after a time delay, an alarm will close the backwash influent and drain valves, and terminate the backwash sequence/

h. The Makeup Reservoir can be manually filled using the Backwash Pump when the filters are not being backwashed. Valves can be operated manually to use finished water from the HSPS Clearwell to refill the reservoir. A pressure transmitter PIT 423 in the line that connects the backwash headers can be used to monitor the depth of water in the Makeup Reservoir, and alarm when full to prevent overfilling the Makeup Reservoir Tank,

5. Filter Headloss:

   a. The filter headloss shall be transmitted to the SCADA from the new DP cell transmitter that is located at the filter.

   b. Electronic trips shall be capable of being redefined through the use of software commands, shall be provided as follows:

      1) Headloss High – Filter Backwash

      2) Headloss High-High – Alarm

6. Filtered Water Flow Meter:

   a. The flow signal shall be transmitted to the SCADA from the new magnetic flow meter transmitter located in the filter effluent line.

   b. The SCADA system shall totalize each filter flow on a daily, weekly, monthly, and to-date base and shall tabulate and store daily average and maximum flows.

7. Sequential Air and Water Backwash:

   a. There shall be two (2) scenarios programmed for filter backwash, including: (1) Sequential Air and Water and (2 Water Only. The sequence shall be selectable from the HMI and shall be locked once a final sequence is selected and changed only by System Engineer or Supervisor with special security level authorization. **The automatic backwash cycle will backwash Cell A first (left cell), then Cell B (right) before the filter to waste cycle is initiated. The filter cell will be ready for operation after both filter cell backwashes have been completed. If the Filter-to-Waste operation is selected to ripen the filter, both Cells A and B backwash must be complete before the filter is ready to be put back into service.**

   b. A typical Sequential Air and Water backwash cycle will consist of the following steps:

      1) Following 60 hours (software adjustable) of filtration time on a filter, the operator will receive a signal from the SCADA that the filter needs to be backwashed.

      2) Close the influent valve to Filter (Cells A and B taken out of service). The filter will continue to operate until the level sensor in the filter is tripped and the timer times out. This will allow the water level to be lowered to about 6" above the media surface.

      3) Close the effluent valve on Filter Cell A and B. When the effluent flow drops to zero flow on each cell the timed backwash sequence will begin.

      4) The automatic backwash cycle will backwash Cell A first (front cell), then Cell B (back cell farthest from influent piping gallery.

      5) Open the drain valves that serves both Filter Cell A and B.

6) Open blower unloading valve if a positive displacement blower is used to supply air.

7) Select Lead/Lag Air Scour Blower. Start Air Scour Blower. Open Filter Air Scour inlet control valve. When the Filter Backwash Sequence program calls for the Air Scour Inlet Valve to OPEN, the Air Header Bypass Control Valve shall be activated to CLOSE.

   a) The blower shall be in AUTO mode, and the blower shall ramp up to set point speed to provide required air flow and pressure at when operating the blower at the setpoint speed and desired air flow.

8) Modulate flow control valve to control air flow to air scour system to maintain set point design air flow rate of (1.5-3 scfm/sf or 500-1,000 scfm) for 5 minutes (Operator adjustable from 2-15 minutes.) One minute before end of air scour duration, start to modulate flow control valve on blower discharge to reduce air flow rate slowly close flow control valve over 60 second period (adjustable by operator).

9) Close air inlet isolation control valve to filter cell A and turn off blower.

10) Open Filter Backwash isolation valve to Filter Cell A.

11) Start Backwash Pump.

12) If EXTENDED AIR AND WATER BACKWASH CYCLE is set to zero (0) minutes, skip to Step 17. If Extended BW Cycle duration is set to between 5 and 15 minutes, Open backwash valve 'Cell A BW' and ramp up the rate of flow to 2 gpm/sf (Adjustable 1-3 gpm/sf or 324 – 1,000 gpm) until water level reaches 6 inches below filter effluent launder trough; and then close Backwash Control Valve.

13) Continue extended air backwash for extended period of 5-minute period (adjustable 5-15 by operator)

14) One (1) minute before end of air scour duration, start to modulate flow control valve on blower discharge to reduce air flow rate slowly close flow control valve over 60 second period (adjustable by operator) to remove air from filter.

15) Slowly close flow air inlet control valve and open-air vent valve on air blower bypass to fully open position. Stop air blower.

16) Immediately after air inlet control valve to Filter Cell "A" is shut, increase backwash water rate to slow rinse filter setpoint of 1,500 gpm (5 gpm/sf) to purge media of air for the balance of the low flow backwash period.

17) Continue to gradually open the backwash valve ‘Cell A BW’ and ramp up the fast rinse rate of flow to 3,240 gpm (10 gpm/sf with rate software adjustable from 8 – 15 gpm/sf by operator). and hold for a 15-minute period (software adjustable 5-20 minutes)

18) Begin to close backwash control valve and ramp down the rate of flow to 1,620 gpm and hold for a 3–5-minute period.

19) Continue to close the backwash Flow Control Valve and ramp down over a 1–2-minute period until the rate of flow equals 0 gpm. Close the Backwash Isolation Control Valve and Turn off Backwash Pump.

20) The backwash for Filter Cell A is complete and backwash will begin for Filter Cell B after a one-minute time delay.

21) Repeat steps 6-19 for Filter Cell B.

22) Close the drain valve.

23) Open the influent valve.

24) The SCADA will prompt the operator to initiate the filter-to-waste sequence. If the filter to waste sequence is desired, then perform the following sequence. If the sequence is not desired, the backwash cycle is complete.

25) Open the Filter-to-Waste drain isolation control valve ‘Cell A FTW’.

26) Start Filter-to-Waste Pump, and after an adjustable time delay, Open the Filter-to-Waste Flow Control Valve on the pump discharge to the desired set point flow rate of 300-600 gpm/sf or 1.0 gpm/sf to 2 gpm/sf. Ramp FTW flow control valve set point flow rate to maintain a filter loading rate of flow up to 2 gpm/sf (adjustable 1-2 gpm/sf or 300-600 gpm (total for 1 filters).

27) Operate Filter-to-Waste Pump for 5 -30 minutes (operator adjustable time). The operator shall be able to end the filter-to-waste cycle at any time during the cycle.

28) Close the filter-to-waste flow control valve for Cell A. When the flow meter reads zero, close valve ‘Cell A FTW and stop the FTW pump.

29) Open valve ‘Cell B FTW’. Start Filter-to-Waste Pump. Open the Filter-to-Waste Flow Control Valve on the pump discharge to the desired set point flow rate of 300 -600 gpm/sf or 1. gpm/sf to 2 gpm/sf. Ramp FTW flow control valve set point flow rate to maintain a filter loading rate of flow up to 2 gpm/sf (adjustable 1-2 gpm/sf or 300-600 gpm (total for 1 filters).

30) Operate Filter-to-Waste Pump for 5-30 minutes (operator adjustable time). The operator shall be able to end the filter to waste cycle at any time during the cycle.

31) Stop the Filter-to-Waste Pump, and close the FTW Drain Isolation Flow Control Valve on the Pump Discharge. Close the filter-to-waste control valves for Filter Cells A and B.

32) When the Filter-to-Waste drain isolation valves for Cell A and B are both signal closed, the filter is ready for operation.

33) Filters (Cells A & B) are ready for service. Open Filter Effluent Valve to send filtered water to clearwell.

8. Backwash cycle (WATER ONLY)

a. Backwash shall be operator initiated. If the high-level alarm in the filter is activated, SCADA shall automatically close the Filter Influent Control Valve and close the effluent flow control valve until the low water level for backwashing the filter is reached in both filter bays.

b. The operator will select backwashing the filter using the Backwash Pump or the Makeup Reservoir.

c. After operator initiates backwash, the backwash cycle shall be an automatic sequence with each component of the cycle a settable input through the operator interface at the filter control console.

d. As a back-up to the automated backwash cycle, each component of the backwash sequence is to be capable of being manually controlled.

e. The backwash cycle shall be also interlocked with either lagoon high level alarm. A software level set point for lagoons shall be configured to allow the backwash cycle.

f. Typical backwash cycle will consist of the following steps:

1) Following 60 hours of filtration time on a filter, the operator will receive a signal from the SCADA that the filter needs to be backwashed.

2) Close the Filter Influent Control Valve. This will close both the A and B sides of the filter. The filter will continue to operate until the level sensor in the filter is tripped and the timer times out. This will allow the water level to drop below the backwash trough, and the filter effluent valves are closed, and the backwash sequence shall begin.

3) The automatic backwash cycle will backwash Cell A first, then Cell B.

4) Open the Backwash Drain Control Valve.

5) Open Backwash Control Valve for Cell A and ramp up the rate of flow to 2,500 GPM and hold for a 4-minute period.

6) Continue to open the Backwash Control Valve for Cell A and ramp up the rate of flow to 4,000 GPM and hold for a 3-minute period.

7) Continue to open the Backwash Control Valve for Cell A and ramp up the rate of flow to 5,250 GPM and hold for a 4-minute period.

8) Begin to close Backwash Control Valve for Cell A and ramp down the rate of flow to 2,500 GPM and hold for a 2-minute period.

9) Continue to close the Backwash Control Valve for Cell A and ramp down the rate of flow to 0 GPM and the Backwash Control Valve for Cell A is completely closed.

10) The backwash for Cell A is complete and backwash will begin for Cell B after a 1-minute time delay.

11) Open surface wash valve 'Cell B SW'.

12) Open Backwash Control Valve for Cell B and ramp up the rate of flow to 2,500 GPM and hold for a 4-minute period.

13) Continue to open the Backwash Control Valve for Cell B and ramp up the rate of flow to 4,000 GPM and hold for a 3-minute period.

14) Continue to open the Backwash Control Valve for Cell B and ramp up the rate of flow to 5,250 GPM and hold for a 4-minute period. No surface wash or air scour is uses.

15) Begin to close Backwash Control Valve for Cell B and ramp down the rate of flow to 2,500 GPM and hold for a 2-minute period.

16) Continue to close the Backwash Control Valve for Cell B and ramp down the rate of flow to 0 GPM and the Backwash Control Valve for Cell B is completely closed.

17) Close the Backwash Drain Control Valve.

18) Open the Filter Influent Control Valve.

19) Filter-to-Waste Process (See Steps 24 – 33 for Air-Water Backwash Sequence.

9. Air Scour Blowers and Valves

a. The SCADA shall provide controls for operations of the air scour blowers and control valves located at each filter bay. When called by SCADA, one air scour blower will start followed by the appropriate Air Control Valve for each filter cell being

backwashed. Air flow to the filter will be varied depending on the backwash sequence (see below for sequential control scenarios). All controls for the blower shall be wired to a local control panel mounted on each air blower unit including Hand-Off-Auto (HOA) controls, local stop/start, run and alarm lights, and transmit blower and motor temperature alarm that provide signals for monitoring and control of the air scour blowers by the SCADA system.

b. Control valves shall be open or close and SCADA shall monitor status signals from the valve.

c. Refer to the Air Scour Blowers below for additional requirements.

10. Air Scour Blowers.

a. Two (2) air scour blowers located in the Mechanical Room shall be integrated into SCADA and HMI for automatic and manual controls.

b. The Air Scour Blower is equipped with control panels that will provide and status signals to SCADA and HMI via PLC-5 for on, off, air flow rate, and alarm conditions (temperature and pressure). Blowers shall be controllable in manual or automatic mode. High pressure or temperature alarms shall call for blower shut down.

c. SCADA shall have a software selector for HOA and for selecting which blower is in service. One or both blowers can be selected to be in service at the same time. Duty and Standby Blower designations shall alternate based on which blower started last

d. With the Air Scour Blowers in Hand, a blower is started, and then the operator must manually open the valve to supply air to a filter cell. In auto, the blower is allowed to start and build up pressure for a short time interval before the filter backwash scheduler calls for the air scour inlet air valve to open.

e. The air scour blowers are equipped with a Slow and Fast speed setting that is controlled by the Filter Backwash Scheduler. After the air scour application is over, the Backwash sequencer closes the air inlet valve and shuts down the Air Scour Blower.

f. This process is repeated for backwashing each filter cell.

g. A leak detection system is equipped with a vacuum pressure switch that will trip on loss of vacuum pressure and abort the filter backwash sequence and stop the air blower after the air inlet valve for the cell has closed.

11. Influent Flume Level:

a. The level signal shall be transmitted to the SCADA system from both the existing and the new level transmitters located at the Influent Distribution Box, as shown on the Contract Drawings. The SCADA shall tabulate and store the daily minimum, maximum and average levels.

b. Electronic trips, which shall be capable of being redefined through the use of software commands, shall be provided as follows:

1) High-High Level: High-High level alarm. Paging Software shall transmit the alarm signal to on-call operators carrying the alpha-numeric pagers. All wellfield pumps shall be called to stop.

2) High Level: High level alarm and alert operators.

3) Low Level: Low level alarm and alert operators.

4) Low-Low Level: Low-low level alarm to alert operators and require the operator to select the number of filters to shut down by closing the individual Filter Influent Control Valves. Filters recommended by the PLC to shut down shall be based on the which filter has had the longest times between backwash cycles (e.g., the filter that was most recently backwash would appear as the last option to shut down).

c. Notes:

1) The Filter Influent Control Valve will be enabled by the operator when flume level has been recovered.

d. The SCADA will receive discrete high-level alarms from the existing backup level electrode located in the flume. The backup level alarm shall be software connected in parallel with high-high level setpoint.

12. Auxiliary Makeup Reservoir Levels

a. The level signal shall be transmitted to the SCADA system from the proposed pressure transmitter located on the backwash line from the Makeup Reservoir where it connects to the filter backwash header in the Pipe Gallery. The pressure transmitter shall be calibrated to record water level in feet based on the pressure transmitter signal as shown on the Drawings. The SCADA shall tabulate the water depth and volume of water stored at the daily minimum, maximum and average levels.

b. Electronic trips, which shall be capable of being redefined using software commands, shall be provided as follows:

1) High-high level alarm. Backwash Pump to be called to stop filling Makeup Reservoir.

2) High level: Reservoir is full; high level alarm and alert operators.

3) Low Level. Low level alarm and alert operators.

4) Low-low level. Low-low level alarm. Do not allow a new backwash sequence to begin.

13. Auxiliary Makeup Reservoir Backwash Sequence:

a. The operation of the Makeup Reservoir for backwashing a filter shall be either automatically from SCADA or manually from the filter control panel as selected by the operator.

   1) Provide LOCAL/REMOTE selector switch to control from SCADA Workstation, or Filter Control.

   2) The Backwash pump is OFF.

   3) Makeups Reservoir Backwash is selected to operate in Manual or Auto. A flow control valve will modulate to control backwash slow rate using set point controls in Backwash Schedule.

b. Software HOA selector switches on Filter Control Panel or in SCADA selected, locking out Backwash Pump from starting.

c. The Makeup Reservoir backwash sequence cannot start unless the tank is at Full Level. Provide white light showing ready on SCADA HMI. Backwash sequence interlocked to abort and reset filter valves if Makeup Reservoir low-level alarm trips.

d. Backwashing sequence for second cell cannot proceed unless adequate water level transmitter signals ready for backwash.

e. The SCADA system shall monitor:

   1) Reservoir storage volume level and volume for each backwash sequence for each cell.

   2) Low and Low-Low water level alarms.

   3) Volume of backwash water used per cell.

f. The SCADA system shall output:

   1) Start-stop signal.

   2) Flow control valve position in % open

   3) The flow from backwashing operations shall be recorded.

   4) Filter backwash step in backwash sequence and remaining time until step is complete and advances to next step. The SCADA Filter Backwash Scheduler shall be provided to set the duration of each step of the filter backwash pump operation. and the speed shall be adjusted to ramp up or down to until the setpoint speed is achieved.

   5) A fault in the operation of any valve controlled by the sequencer. After an adjustable time delay, backwash sequence is aborted, and Alarm announced.

g. The SCADA shall automatically alternate the pumps on each cycle.

h. Provide selector switch on each filter console to select whether to use the Backwash Pump or Makeup Reservoir for backwashing a filter.

1) Provide selector switch and indicating light on existing Filter Console to select Backwash Pump/Makeup Reservoir Pump.

2) Update HMI display to select source of backwash water and totalize flow from each source.

14. Refer to I/O schedules for complete list of control and monitoring requirements for the filter process equipment.

B. New PLC No. 7 (Main control panel at Sugar Creek WTP):

1. High Service Pump Clearwell:

a. The level signal shall be transmitted to the SCADA system from the new level transmitter located at Pump Chamber No. 1 and No. 2 as shown on the Contract Drawings. The SCADA shall tabulate and store the daily minimum, maximum and average levels.

b. Electronic trips, which shall be capable of being redefined using software commands, shall be provided as follows:

1) High-High-High Level: High-high-high level alarm to call all Filter Effluent Control Valves to close.

2) High-High Level: Activate high-high level alarm. Paging Software shall transmit the alarm signal to on-call operators carrying the alpha-numeric pagers. All wellfield pumps shall be called to stop.

3) High Level: High level alarm and alert operators.

4) Low Level: Low Level Alarm and alert operators.

5) Low-low Level: Low-low level alarm to require the last pump called to start to be disabled. The backwash pump shall be called to Stop if in operation when this alarm is activated, until a normal operating level is reached in the well and the backwash cycle shall be restarted to the beginning for the filter.

6) Low-low-low Level: Low-low-low- level alarm to call all high service pumps to stop.

c. Notes:

1) The high service and backwash pumps will be enabled by the operator when pump chamber level has been recovered. If a backwash cycle is in sequence when the low-low level alarm is active, backwashing shall stop for that cell and restarted to the beginning by the operator when the water level returns to a normal value.

2) The wellfield pumps will be enabled by the operator when the level is dropped below the software setpoint.

d. The SCADA will receive discrete low-level alarms from the existing backup level electrodes located in the pump chambers. The backup level alarms shall be software connected in parallel with setpoints.

2. High Service Pumps 1 to 5:

   a. The operation of the high service pumps shall be manually started from SCADA as selected by the operator.

      1) High Service Pumps 1, 3, 4, and 5 are constant speed pumps and are equipped with 5 KV motors with the motor starters located in the Electrical Room.

      2) High Service Variable Frequency Drives will be provided with a 480-volt motor and VFD will be in the Electrical Room.

      3) The operation of all five pumps is equipped with the same level, ball check surge control valve, and pressure transmitter and motor winding temperature sensors, and all pumps will be controlled in the same manner except for the speed control for the Pump #2 VFD.

      4) Pump #2 shall be operated by selecting a speed setpoint using a keypad in the VFD or from SCADA. The pump will run at a constant speed, but the flow may vary with changes in water level in the clearwell, or variation in system head depending on the number of pumps in service and the water level in water storage tanks in the distribution system.

      5) High Service Pumps 1, 3, 4, and 5 will operate in the same manner as the other Pump #2/

   b. The operation of the high service pumps is combined with operation of the pump's discharge motor operated surge control ball check valve as shown on the drawings. SCADA will monitor and control open and close position of the valve, and alarm on a Fault in the local surge controls.

   c. Software HOA selector switches and alternating function shall be provided with all five high service pumps. Run time for each pump will be indicated and totalized.

   d. After a preset time delay, should the "actual" pump status disagree with the "called" status or the surge control valve status, then a pump fail alarm shall be activated.

   e. The SCADA system shall monitor:

      1) Pump status from each starter.

      2) Pump fail indication from each starter where applicable.

      3) Motor Winding High Temperature will trip Fault indication.

      4) H-O-A selector switch position

      5) Stop/Start push button

   f. The SCADA system shall output:

      1) Pump start-stop signal to each starter and associated ball check valve.

3. Backwash Pump:

a. The operation of the backwash pump shall be either automatically from SCADA or manually from the pump starter as selected by the operator.

1) Provide LOCAL/REMOTE selector switch to control from SCADA Workstation, or Filter Control.

2) The Backwash pump shall be provided with a Variable Frequency Drive, and the pump speed shall be controlled from the HMI in AUTO or HAND position.

b. Software HOA selector switches and alternating function shall be provided with all washwater pumps.

c. The pumps shall be interlocked to stop with the clear well low-level alarm.

d. After a preset time delay, should the “actual” pump status disagree with the “called” status, then a pump fail alarm shall be activated.

e. The SCADA system shall monitor:

1) Pump status from each starter, discharge pressure at two (2) locations as shown on Contract Drawings, position of the flow control valve, and flow

2) Pump fail indication from each starter where applicable.

f. The SCADA system shall output:

1) Pump start-stop signal to each starter.

2) Pump speed.

3) The flow from backwashing operations shall be recorded.

4) Filter backwash step in backwash sequence and remaining time until step is complete and advances to next step. The SCADA Filter Backwash Scheduler shall be provided to set the duration of each step of the filter backwash pump operation. and the speed shall be adjusted to ramp up or down until the setpoint speed is achieved.

5) A fault in the VFD for the Backwash Pump shall be alarmed and shut down the pump and stop the advance the filter backwash program to the last step and shut down all filter operations.

6) Provide selector switch on each filter console to select whether to use the Backwash Pump or Makeup Reservoir for backwashing a filter.

7) Provide selector switch and indicating light on existing Filter Console r to select Backwash Pump/Makeup Reservoir Pump.

8) Update HMI display to select source of backwash water and totalize flow from each source.

4. Filter Clearwell Levels

a. Water level signals shall be transmitted to the SCADA from the new submersible level transmitter located in the Clearwells 1, 2 and 3 that receive filtered water from Filters 1 to 6. The SCADA system shall display the water depth in feet and gallons, and tabulate and store the daily minimum, maximum and average level in each clearwell chamber, and the combined total actual storage volume.

b. Electronic trips shall be capable of being redefined using software commands, shall be provided as follow:

1) High Level: High level alarm and notify the operator.

2) Low Level: Low level alarm and notify the operator.

5. Chlorine Contact Tank Levels

a. Water level signals shall be transmitted to the SCADA from the new submersible level transmitter located in the North and South Chlorine Contact Tanks. The SCADA system shall display the water depth in feet and gallons, and tabulate and store the daily minimum, maximum and average level in each clearwell chamber, and the combined total actual storage volume.

b. Electronic trips shall be capable of being redefined using software commands, shall be provided as follow:

1) High Level: High level alarm and notify the operator.

2) Low Level: Low level alarm and notify the operator.

6. Fluoridation Clearwell Levels

a. Water level signals shall be transmitted to the SCADA from the new submersible level transmitter located in the existing Chlorine Contact Tank that has been converted to a Fluoridation Tank that receive the flow from North and South Chlorine Contract Tanks. The SCADA system shall display the water depth in feet and gallons, and tabulate and store the daily minimum, maximum and average level in each clearwell chamber, and the combined total actual storage volume.

b. Electronic trips shall be capable of being redefined using software commands, shall be provided as follow:

1) High Level: High level alarm and notify the operator.

2) Low Level: Low level alarm and notify the operator.

7. Fluoride Analyzer

a. A Fluoride Residual Analyzer is in the new Fluoridation tank that treats chlorinated water prior to directing flow into the High Service Clearwells 1 and 2 and the finished water header.

b. The SCADA shall receive a signal from the fluoride analyzer and provide an indicator and alarm light in the local analyzer and

generate an alarm in SCADA when activated. The fluoride chemical feed pumps are operated manually, and not paced by fluoride concentration.

8. Residual Chlorine Analyzers

    a. New Residual Chlorine Analyzers will be installed to monitor the chlorine residual of the influent to the Clearwell 3 where flows from Filter 1 to 6 are combined, and at the influent to the North and South Chlorine Contacts, and the Finished Water header leaving the plant.

    b. The SCADA shall receive a signal from the chlorine residual analyzer and provide an indicator and alarm light in the local analyzer and generate an alarm in SCADA when activated.

9. Filter Pipe Gallery Tunnel Sump Pumps (Between Filters 2/3 and 5/6, and Elevator Pit Sump Pump)

    a. Tank Level (typical for each tank)

    b. Each sump pump is provided with a local NEMA 4x control panel that is provided by pump manufacturer, and includes disconnect switch, motor starter, relays, and control power transformer. Float switches are provided for Pump Start-Stop- and High-Level Alarm. Each pump is provided with H-O-A switch for manual start-stop- or automatic control using the high-low float switches installed in the sump. Indicator lights are provided to indicate pump running, fault and high alarm. A remote signal is provided to transmit the following to the SCADA system.

    c. Flood Alarm. When activated the high-level alarm signal shall be transmitted to the SCADA for alarm functions.

10. Plant Effluent Water Flow:

    a. The flow signal shall be transmitted to the SCADA from the new magnetic flow meter located in a valve vault on the high service main header as shown on the drawing.

    b. The SCADA system shall totalize flow on a daily, weekly, monthly, and to-date base and shall tabulate and store daily average and maximum flows.

    c. The SCADA system shall be capable of outputting an analog signal for total finished water flow to designated chemical feed systems for future automatic pacing control.

11. Plant Effluent Pressure:

    a. The pressure signal shall be transmitted from the existing pressure transmitter located on the high service main header as shown on the drawings.

    b. The SCADA shall trend and tabulate hourly, daily and weekly pressure.

12. Surge Relief Valve

a. A 16” pressure relief valve is installed in the Surge Relief Valve Chamber installed on a 16” water line tied to the main finished water header. The valve has a position switch indicating the valve that sends a signal to SCADA to alarm valve operation.

b. The pressure signal shall be transmitted from a new pressure transmitter located upstream of the surge relief valve service that relieves the excess surge pressure through a new 16” line that discharges into the Makeup Reservoir fill line as shown on the drawings.

c. The SCADA shall trend and tabulate hourly, daily and weekly pressure.

13. In-Plant Potable Water Flow:

a. The flow signal shall be transmitted to the SCADA from the new magnetic flow meters located. on the piping distribution system located along the west wall of the first floor Filter Gallery Annex. Plant water is meter by two magnetic flow meters that supply water to the two chlorinators and in plant potable water distribution system as shown on the drawing.

b. The SCADA system shall totalize flow on a daily, weekly, monthly, and to-date base and shall tabulate and store daily average and maximum flows.

c. The SCADA system shall be capable of outputting an analog signal for total finished water flow to designated chemical feed systems for future automatic pacing control.

14. Analytical Equipment

a. The SCADA shall receive output signals proportional to the measured turbidity, pH, chlorine, fluoride, etc. from the respective analyzers and shall tabulate and store minimum, maximum and daily average values. Alarm signals shall be output should finish water turbidity, pH, chlorine, fluoride levels fall out of the established range at the SCADA. The alarms shall be enabled only if the plant is running.

15. Plant Power Monitoring

a. The SCADA shall input plant normal and emergency power status and kW usage signals from the gear for monitoring functions.

b. The SCADA shall also receive discrete signals from the Automatic Transfer Switch for load shedding and step loading functions. Under emergency power in the SCADA shall disable operation of selected high service pumps as selected by the operators. Each pump shall be provided with a software selector switch to select between normal and stand-by power.

16. Refer to I/O schedules and P&IDs on the drawings for complete list of control and monitoring requirements for the process equipment.

C. Modified RTUs No. 1 through No. 10 (at Sugar Creek well field)

1. Wells 2, 4 and 9

a. Variable Frequency Drives will be provided for Well Pumps 2, 4, and 9. The VFD will be in the MCC for these wells.

1) The operation of all three pumps is equipped with the same level, flow and pressure sensors and will be controlled in the same manner as the constant speed pumps.

2) The speed setpoint will be adjustable manually from the in the VFD or from SCAD. The pump flow when running at a constant speed may vary with change in water level in the well, or variation in system head depending on the number of pumps and aerators in service.

3) Wells 2, 4, and 9 will operate in the same manner as the other Wells 1, 3, 5, 6, 7, 8 and 10

b. Wells 1, 3, 5, 6, 7, 8 and 10 will be constant speed pumps.

2. Well Water Level (Typical for 10 wells):

a. The well level signal shall be transmitted to the SCADA from the new submersible level transmitter located inside the well. The SCADA shall tabulate and store the daily minimum, maximum and average level.

b. Electronic trips shall be capable of being redefined using software commands, shall be provided as follow:

1) High Level: High level alarm and notify the operator.

2) Low Level: Low level alarm and well pump disabled and notify the operator.

c. Note: The well pump shall be enabled by the operator when the well level has recovered after a preset time delay and low-level alarm is no longer activated.

3. Well Water Flow Meter (typical for each well):

a. The flow signal shall be transmitted to the SCADA from the new magnetic flow meter installed in the Well Building for each pump.

b. The SCADA system shall totalize the flow on a daily, weekly, monthly, and to-date base and shall tabulate and store average and maximum flow.

c. The SCADA system shall activate an alarm if the flow rate drops below a predetermined setpoint.

4. Well Pumps (typical for each well):

a. An HOA switch in the RTU will be provided to allow manual operation of the pump, and override level, flow, and pressure controls. he operation of the well pump shall be manually started from the SCADA as selected by the operator.

b. Software HOA selector switches shall be provided with all well pumps. The Auto status will be transmitted from the RTU to the

SCADA system. A fault in the motor start will be transmitted and alarmed in the SCADA system

c. After a preset time delay, should the "actual" pump status disagree with the "called" status then a pump fail alarm shall be activated.

d. The SCADA system shall monitor:

1) Pump Auto and Run status from each starter.

2) Pump fail indication from each starter where applicable.

e. Remote and Local Pump Start-Stop.

1) The SCADA system shall output:

2) Pump start-stop signal to each starter.

3) Pump running status

f. The well pump shall be interlocked shut down with the well low level, high pressure, and no flow alarms as described herein.

g. A pressure transmitter on the discharge of each pump is located upstream of the check valve and isolation valves. A high-pressure alarm will signal a closed valve and stop the pump and signal an alarm. The well pump shall be called to stop if a dead head pressure is recorded or if temperatures in the motor are above the present value as recommended by the motor manufacturer of the well pump.

5. Refer to I/O schedules and P&IDs shown on the drawings for additional requirements.

D. Modified PLCs s No. 8 and 9 (East and West Aerators at Sugar Creek WTP):

1. Raw Water Flow (typical for each Aerator):

a. The flow signal shall be transmitted to the SCADA from the new magnetic flow meters installed in meter vaults on the raw water mains supplying raw water to the East and/or West Aerator. A signal converter located at the building/metering pit will transmit the flow signal to the PLC in the Aerator Buildings,

b. The SCADA system shall totalize the flow on a daily, weekly, monthly, and to-date base and shall tabulate and store average and maximum flow.

c. The flow signal shall be configured as the feedback signal for the flow control valve PID loop that modulates to control the flow directed to each Aerator Building as described herein.

2. Raw Water Flow Control Valves (typical for each Aerator):

a. The SCADA shall transmit an analog signal to the existing flow control valve actuators to modulate the valves based on a software predetermined flow rate through a software PID loop.

b. A software selector switch including the valve open/close target position shall be provided to allow the operator to modulate the valve manually or automatically through the software PID loop.

In addition, the SCADA shall receive the valve position status for indication and monitoring functions.

c. Upon high level alarm in the plant influent flume the feeds the filters or the clearwell levels below the filters shall be transmitted to the SCADA system shall shut down the well pumps and activate alarm functions.

3. Valve Vault Flood Alarm (typical for each aerator):

a. The flood detection switch located on the floor of each valve vault shall initiate an alarm signal that shall be transmitted to the SCADA for alarm functions.

4. Clearwell High Level Alarm (1 in East Aerator and 2 in West Aerator)

a. The Clearwell water level signal shall be transmitted to the SCADA from the new submersible level transmitter located inside the well. The SCADA shall tabulate and store the daily minimum, maximum and average level in each clearwell.

b. Electronic trips shall be capable of being redefined using software commands, shall be provided as follow:

1) High Level: High level alarm and notify the operator.

2) Low Level: Low level alarm and notify the operator.

5. Refer to the I/O schedules and P&IDs on the drawings for additional requirements.

E. Modified PLC No. 10 (Fluoride Building at Sugar Creek WTP):

1. Fluoride Chemical Bulk & Day Tank Level:

a. Level signals for each chemical bulk tank shall be transmitted to the SCADA from the new level transmitters located at each tank.

b. The SCADA shall display the liquid level depth in feet and gallons, and tabulate and store the daily minimum, maximum, and average level. Electronic trips shall be capable of being redefined using software commands, shall be provided as follows:

1) High Level: High Level Alarm and notify the operator.

2) Low Level: Low Level Alarm and notify the operator.

c. Weight signal for the day tank scale shall be transmitted to the SCADA from the new scale located at the day tank. SCADA shall calculate net remaining, feed rate, daily usage, total amount used, time until empty, gross weight, and volume for graphic indication, Low- and High-Level alarms and controls. SCADA shall tabulate and store the daily minimum, maximum and average weight.

2. Fluoride Chemical Feed Pumps (Typical For 3 Pumps)

a. Each chemical feed pump is provided with a Pump Control Display Panel that includes HOA switch with Off, manual start, or to run in Auto the feed rate is proportionally paced with the finished water flow signal. An adjustable dial is provided to set

the pump feed rate. Indicator lights are provided for Pump Running, Stopped, and Fault.

b. The SCADA system shall monitor:

1) Pump status from each pump.

2) Pump fail indication for each pump

3) Provide for future

c. The pumping program shall be one (1) pump to each fluoride injection point on the north and south end of the chlorination chamber with one (1) pump interlocked, with valving, to serve as a standby pump in the scenario where the duty pump is out of service. Valving to the standby pump shall remain normally close whereas valving to the two (2) duty pumps shall normally remain open.

1) Surface water shall be fed to the Diffuser per the details provided in Contract Drawings.

d. Fluoride Fill Station Spill Pad Diverter Valve

1) A three-way motor operated valve is provided in a valve vault adjacent to fluoride fill station. When not in use the valve is open, and the any drainage from the spill collection pad is drained to the local sewer. A local control panel at the Fluoride Fill Station allows the operator to select to Storm Sewer or Containment Sump.

2) A selector switch and pilot light indicating which position has been selected is displayed, and relays provided to transmit to the SCADA system:

3) Valve status showing Storm Sewer or Containment Sump shall be displayed and alarmed.

4) During truck filling operations, the Containment Sump is selected on the local panel, and the valve switch to divert flow to the containment sump during filling operations.

a) A high level in the Pump Out Sump is displayed on the local panel, and a signal it sent to the SCADA system to be displayed and alarmed.

5) Safety Shower and Eyewash Station. The SCADA shall be capable of receiving an alarm if the emergency eyewash and/or shower flow switch supplied with the safety shower unit is activated and notify the operator.

6) Fluoride Interior Containment Sump:

a) Alarm in SCADA that Safety Shower Activated

b) Exterior Fluoride Filling Station:

7) Alarm in SCADA that Safety Shower Activated

3. Fluoride Containment and Pump Out Sump

a. Containment Sump. A high well level signal that shall be transmitted to the SCADA from the new submersible level

switch located inside the well. The high alarm signal shall be transmitted to the SCADA for alarm function as follows.

1) High Level: High Level Alarm and notify the operator.

b. **Fluoride Exterior Pump Out Sump**. A high well level signal that shall be transmitted to the SCADA from the new submersible level switch located inside the well. The high alarm signal shall be transmitted to the SCADA for alarm functions as follows.

1) High Level: High Level Alarm and notify the operator.

4. Chlorine Ton Cylinders (Existing)

1) Two weigh scales are provided to measure the weight of chlorine gas cylinders. The SCADA shall receive a weight signal from the two (2) separate ton cylinders and generate an alarm when the weight of a ton cylinder reaches a value that represent an empty weight void of chlorine gas.

5. Chlorine Vacuum Switch and Chlorinators

a. SCADA shall receive the loss of vacuum signal from the chlorine vacuum switch installed on the gas line feeding each Chlorinator and generate an alarm when activated. Two (2) chlorinators shall distribute chlorine to the various feed points as specified in Contract Document through one (1) 75 PSI distribution panel and one (1) 150 PSI distribution panel.

b. Chlorine Leak Detection Alarm

1) The SCADA shall receive an alarm signal from the chlorine gas leak panel that monitors for chlorine gas in the Chlorine Cylinder Storage, Evaporator Room, and Observation Room and generate an alarm when activated.

2) The SCADA system shall send provide an output signal to the increase the HVAC fan and exhaust fans to high speed when a gas leak is detected. The SCADA system shall indicate the change in status of the HVAC and Exhaust Fan shall be indicated of the units shall be indicated

6. Generator Control description

a. The level signal shall be transmitted to the SCADA from the new level transmitter located at tank valve vault. The SCADA shall tabulate and store the daily minimum, maximum and average level and shall calculate and indicate the tank volume.

b. Electronic trips shall be capable of being redefined using software commands, shall be provided as follows:

1) High-Level: High Level Alarm.

2) Low Level: Low Level Alarm.

c. Rate of change alarm.

PART 2 PRODUCTS

2.1 SCADA SOFTWARE AND HARDWARE

A. SCADA Software

1. The following software shall be provided at the **Sugar Creek WTP**:

a. One full function development, Allen-Bradley 9701-VWSS000LENE Factory Talk View Site Edition Server unlimited display WS RSLINX and 9701-VWSTENE Factory Talk View Studio for Factory Talk View and 9701-VWSCWAENE Factory View Site Edition Client. The software shall be configured as a primary FT Server.

b. One full function Allen Bradley 9701-VWSS000LENE Factory Talk View Site Edition Server unlimited display with RSLINX and 9701-VWSCWAENE Factory View Site Edition Client. Software shall be configured as a backup FT Server and two Allen Bradley 9701-VWSS000LENE Factory Talk View Site Edition with RSLINX and 9701-VWSCWAENE Factory View Site Edition Client for two desktop computers.

c. One PLC programming software license Allen Bradley RSLogix 500 Professional (Cat.# 9324-RL07))NXENE) and one 5000 licenses for the specified PLC's (9324-RLD/7000NX).

d. One pager software at SCADA node 1 to transmit the software selective alarms associated with the Sugar Creek Plant process and well field to a central alarm processing agency which in turn will retransmit the alarm signal to on-call operators carrying the alpha-numeric pagers. Paging software shall be Spector version 7.0, Win 911 and 411. The Automatic Dialing and Voice Annunciation Alarm Management System shall consist of a true 32-bit Microsoft Windows based software, which shall be compatible with Windows Server 2003 and Windows XP. The Alarm Management System shall be capable of bi-directional communication with other 32-bit Application Software packages. Software and hardware must be capable of accomplishing the following tasks:

1) Upon Alarm condition: facilitate the display of alarm information to the screen of a Windows based computer system. Must additionally be able to display alarm information to the screen while other Windows based application software is running.

2) Allows for Voice Dial-in Connection via telephone line to facilitate the acknowledgement of active alarms.

3) Allows for Voice Dial-In Connection via telephone line to facilitate the inquiry of and the alteration of values of digital or analog tags.

4) Shall allow for the creation and maintenance of "reports" or organized collections of tags. Such reports may be voice accessed via telephone line employing a mandatory password protection system. The report

feature shall make it possible to inquire and receive a verbalization of the description of the tag requested, along with the current value. It shall also be possible to alter any analog or digital value through a verbalized verification process. This alteration process calls for the pre-configuration of the tag, making it available for inquiry and/or change. A tripe redundant password protection scheme must be satisfied to change values. Both Win 911 residing in the two SCADA computers shall be configured with automatic redundancy. Upon failure of the active Win 911, two backup Win 911 shall be activated and shall resume the alarm paging functions.

5) One Sytech report manager.

6) All other necessary software for the database upgrade & to provide a fully functional SCADA system. The system integrator shall provide all necessary hardware, software, and data base reconfiguration for complete integration between the two existing Sugar Creek and Northwest water treatment facilities SCADA systems and the Northeast water treatment facility's new SCADA system over the wide area network (WAN) for controls, monitoring and data exchange functions between all three facilities.

B. SCADA HARDWARE

1. The following new SCADA hardware shall be provided at the Sugar Creek WTP:

a. Three workstation computers complete with Windows 10 operating system.

b. Three 32-inch active-matrix color monitors.

c. Two rack mounted servers.

d. Network cabinet including the rack mounted managed Ethernet switches, fiber optic media converters, power supplies, UPS, router and auxiliary systems.

e. Data communication including fiber optic and CAT 6e cables and interconnection wiring.

f. Ethernet LAN, with PCI NIC cards.

g. Ethernet switches and routers.

h. Workstation furniture and accessories.

i. Wide area network router and accessories.

j. UPSs

k. Log and report printer.

l. One laptop computer.

m. Fiber optic patch panel, converters, and accessories

n. Additional hardware and peripherals as shown on the drawings

o. Four new PLC panels (electric room, fluoride room, east and west aerator buildings) including, but not limited to, PLCs, control devices, UPS, power supplies, door mounted HMI panels , etc.

p.

q. Interfacing to existing panels, starters, instrumentation, etc., as shown on the drawings.

r. Ten new RTUs including, but not limited to new PLCs, OITs, UPS, fiber optic, etc.

s. Modifications to six existing consoles including providing new AB CompactLogix PLCs, I/Os, power supplies, UPS and HMI panels to replace exisitng.

t. Associated devices as required to provide complete, fully operational system.

u. One wall mounted 57-inch LCD monitor to be integrated into the SCADA system. The monitor shall be 57-inch LCD, HDTV flat screen with 1920X1080 resolution, contrast ratio:10000:1, comb filter: 3D digital, video input, PC input and Vision Mount universal wall mount heavy duty steel hardware (black finish) with axis tilt adjustment system and hinged extension arms as required. Provide all necessary accessories including the coaxial cable, video/graphic card, etc.

2.2 SYSTEM HARDWARE

A. Server Class Computers

1. The rack mounted, server class computers shall be furnished with all hardware, software, and application programming, as required. The servers shall be multi-tasking capable of executing programs concurrently and shall be able to communicate to PCs, PLC's, and associated peripherals for process control and data acquisition system.

2. The servers shall be industry standard, DELL PowerEdge R340 with PowerEdge R340 MLK Motherboard and 3.5" chassis with up to 4 Hot Plug hard drives, Intel Xeon E-2224 3.4GHz, 8 M cache, 4C/4T turbo processor, 64-bit, , 64.0 G of RAM, three solid-state hard drives with minimum of 1TB of data storage each, BOSS controller card with 2 M.2 Sticks 240G, LP, Window server 2019, additional network card: on-board Broadcom 5720 dual port 1Gb LOM, internal optical drive: DCD +/-RW SATA, power supply: dual hot plug, redundant power supply, power cords, rack rails and all necessary hardware and software as required.

3. The server class computers shall be industry standard, DELL PowerEdge R340 with PowerEdge R340 MLK Motherboard and 3.5" chassis with up to 4 Hot Plug hard drives

4. The Owner shall be supplied with a 3-year on-site warrantee and lifetime telephone support 7 day/week, 24 hr/day.

5. All necessary devices and hardware to provide a fully functional system.

B. Color Monitors

1. The operator's console consisting of a function keyboard and color graphic monitor shall serve as the primary device for the interface between man and machine for operating of the system.

2. The monitors shall be 32-inch LCD flat screen, as specified, VGA standard, with .26dp or better black mask contract, 256K colors, and brightness and contrast controls.

3. The monitors shall be capable of a minimum of 1024 by 768 non-interlaced resolution at a refresh rate of at least 72 Hz.

C. Mass Storage Drivers

1. Provide two 2TB external hard drive units. HP or equal product.

D. Printer

1. The SCADA operator's console shall include a report printer to print Process averages, status of process variables, and hourly, shift, daily, monthly and demand logs. Equal to Hewlett Packard Color LaserJet CP2025 or latest version with Ethernet card.

E. Laptop Computer

1. The remote laptop computer shall be finished complete with hardware and software and communication program necessary to communicate with SCADA computer system for monitoring the treatment plant facility and remote stations and shall be delivered new, unopened.
2. The computer shall include Intel i-7, 64-bit processor, 16GB RAM, 1TB solid-state hard drive, 15" display, internal network and wireless broadband cards complete with carrying case.
3. The laptop shall be prewarned and configured with MS Windows latest version, MS Office, MS Internet Explorer and McAfee Virus Scan. The computer shall be DELL or HP.
4. The laptop computer shall be provided with the following features:
    a. Built-in touch pad pointing device
    b. Battery package and charger
    c. Carrying case
    d. Standard one-year on site and 3-year total extended replacement warranties

F. Desktop Computers

1. The desktop computers shall be furnished with all hardware, software, and application programming, as required. The computers shall be multi-tasking capable of executing programs concurrently and shall be able to communicate to PLC's, remote SCADA computers and associated peripherals for process control and data acquisition system.

2. The computers shall consist of Intel i-7 Pentium processors microcomputer with turbo booster, 64-bit, , 32.0 G of RAM, a solid-state hard disk with minimum of two terabyte (2TB) of data storage, CD-RW, DVD-RW drive, speakers, sound card, Ethernet card, and 4 USB ports or greater as required. . Video card shall be industry 512 MB VGA and shall have on-board VRAM to allow 1024 by 768 resolution with a minimum of 256K colors and will be installed on the AGP local bus.

1. The computers shall be a personal computer, industry standard, PCI local bus, with MS Windows 10 professional or Enterprise Edition, DELL or HP.

2. The Owner shall be supplied with a 3-year on-site warrantee and lifetime telephone support 7 day/week, 24 hr/day.

3. Microsoft small office, professional edition, Outlook and McAfee antivirus, Spyware scan software.

4. All necessary devices and hardware to provide a fully functional system.

5. Three-year next business day on site warranty services.

G. Network Cabinet

The SCADA network cabinet shall be NEMA 1 construction, ventilated, housing the rack mounted servers, managed Ethernet switches, router, Fiber patch panel, power supplies, etc.

1. The network cabinet shall be Panduit, Net-Access, S-style, or approved equal, sized as required to house the specified rack mounted equipment. The network cabinet shall include the Power distribution, Panduit model: V1B2B1M2M24AKA0.

2. Refer to specifications section 40 9533 06 for network switches requireents.

H. Uninterruptible Power Supplies (UPS)

1. Uninterruptible power supply with a minimum of 30 minutes backup and 1000 VA capacity shall be provided; one at each location for operation of SCADA computer and peripherals.

I. PLC & RTU Panels

1. The panels shall be preassembled, prewired, and include all the necessary controls as specified herein and shown on the drawings. The Contractor shall take full responsibility for the unloading the panel and moving it into place as shown on the drawings.

2. The panels shall consist of floor or wall or floor-mounted, non-modular assembly as shown on the drawings. The panels shall be NEMA 12 type for indoor, dry locations and NEMA 4X stainless steel for east and west aerator buildings and NEMA 4X, non-metallic for the Fluoride building as shown on the drawings, Total access shall be available from the front with access doors to all interior wiring and components.

3. Wiring shall be general purpose, open type, neatly bundled and lace door installed in plastic wiring troughs. Wire shall be No. 16 AWG minimum with 300-volt, 75 C rated thermoplastic insulation. Wiring shall comply with the latest National Electrical Code. Power and low voltage DC signal wiring shall be routed in separate wiring troughs. Parallel troughs of different systems shall be separated by a minimum six inches.

3. All panel wiring to external equipment shall be terminated on-screw-type terminal strips. Terminal blocks shall be arranged in vertical rows and

separated into groups (power, AC control, DC signal, etc.) All terminals shall be labeled or otherwise identified for field connections. The terminal strips shall be provided with a minimum of 25 percent spares.

4. The filter control consoles, the main control panel at Sugar Creek WTP and MTU at Northeast WTP shall be provided with door mounted Allen Bradley 12-inch color, PanelView plus OITs. RTUS No. 14 through 19 shall be provided with AB PanelView 600 Plus, color OITs.

5. Refer to the drawings, for PLC elevation, wiring diagrams and complete

6. list of hardware requirements.

J. PLCs

1. The PLCs shall include memory and software to allow customer configurable programming in the field. Reprogramming shall be either by downloading from the SCADA computer over the communications channel or using the programming unit to all PLCs.

2. The PLC shall control its local process using an integral processor and modular real-time process control software.

3. The PLCs shall be capable of communicating with the master PLC in continuous polling mode and shall be provided with communication modem.

4. All Status inputs to the PLC's shall be optically isolated.

5. Interposing relays for control output shall be provided with a minimal contact rating of 10 amps at 120 VAC.

6. The PLCs shall be provided with one serial port and one Ethernet for communications with the radio communication protocol and the SCADA network.

7. Built-in real time clock and calendar which maintain the time and date accurately through a power failure.

8. Operates from DC power which may vary from 12 to 30 Vdc. A 120 Vac source shall be the only power to the PLC's.

9. The PLC shall have an operating temperature range of 0 to 55°C.

10. Runs comprehensive self-test diagnostics at power on, or upon command via the network, which verify the integrity of the PLC and its I/O hardware.

11. Includes watchdog circuitry which detects a failure of either the PLC’s hardware or software and provides an output signal if such a failure occurs. To optimize network traffic and to confirm to AB recommended programming practices, programs shall use tag of user defined type (UDT). These UDT’s shall consolidate PLC data into logical groups.

12. Supports all industry standard communications baud rates from 300 baud to 38.4K baud. The communications rate shall be easily configurable by the user, and be compatible with the communication interface, i.e., modem, radio, etc.

13. Supports peer-to-peer network operation, allowing for PLC to PLC and host computer to PLC communications.

14. Uses an error detection and correction protocol for error-free communications over twisted pair wires, telephone leased lines, commercial telephone service, and radio data links.

15. Standard off-the-shelf communications software shall be available for an IBM/PC compatible computer which supports this protocol without writing custom drivers and interface software.

16. The PLC's microprocessor software, configuration information and logged data shall be maintained in battery backed CMOS RAM memory, with a service life of ten years or greater and transferred to flash memory.

17. User programmable to support custom logic functions using relay ladder logic.

18. Capable of performing control and data collection tasks as a stand-alone device, on-line or off-line from the communications network.

19. The PLC shall have the ability to have its programming and configuration software updated or replaced by download through the network communications port; either locally, or remotely (via the network) without local operator intervention.

20. All critical setpoints, time values and operating parameters shall be user configurable and retained in non-volatile flash memory.

21. Supports operation with the specified SCADA software operating on an IBM/PC compatible computer. The SCADA software driver must be currently available, not requiring custom programming for this project.

22. All PLC I/O and Power connections shall use high quality removable plug-on connectors for ease of installation and maintenance, and rapid field replacement.

23. The PLC shall be capable of supporting a minimum of 32 digital I/O points. Each digital point shall be easily field configurable for operation at either 24 Vdc or 120 Vac. Outputs shall be of solid-state design, capable of switching loads of up to 3 Amps. All digital I/O points shall be fully optically isolated.

24. The PLC shall be capable of supporting up to 8 analog inputs and 4 analog outputs. Each analog input shall have 14-bit resolution and shall be easily user configurable to support 0-1 Vdc, 0-10 Vdc, and a 4-20 mA. Input signal ranges, individually settable by channel. All analog inputs shall be fully isolated differential types, capable of rejecting electrical interference normally associated with industrial equipment including, but not limited to transformers, motor starters contactors, and electrical heaters. The analog outputs shall be configured for current loop operation (0-20 mA/4-20 mA). A minimum of 10% I/O’s of each type shall be provided.

25. The processor shall include additional instructions including PID messaging, selectable timed interrupts, floating-point math, and on-line programming. The CPU shall be capable of at least 256 digital I/O of any mix. The SAU time shall be no greater than 2.5 MS/K of logic. In addition, the processor shall support reading of writing ASCII strings.

26. The PLC shall perform all on-line local control functions by means of a control program maintained within the unit's memory. In the event of a system or communications failure, it shall continue to control its assigned process and shall store all necessary data for transmission when communication resumes. It shall also be capable of store and forward message functionality for radio telemetry applications.

27. The MTU PLC shall function as the overall system coordinator, controller, telemetry master, and shall be provided with standard protocol for communication with remote units.

28. IN EACH PLC PANEL, PROVIDE 20% SPARE I/O (ROUNDED UP) BASED ON THE SPECIFIED CONNECTED I/O. FOR ANALOG I/O PROVIDE A MINIMUM OF 4 ANALOG INPUTS AND 4 ANALOG OUTPUTS FOR EACH PANEL. ALL SPARES SHALL BE WIRED TO TERMINAL BLOCKS OR INTERPOSING RELAYS.

29. The PLCs shall be Allen-Bradley CompactLogix with on-board Ethernet port for PLCs 1,2,3,4,5,6, 7 8, 9 & 10. All RTUs for wells 1-10 shall be Allen Bradley MicroLogix 1400. All PLCs and RTUs shall be provided with Ethernet switches and fiber-to-Ethernet converters and patch panels as required.

K. HMI Panels (PLCs 1 thru 10)

1. The PLCs shall be equipped with HMI panels for control and monitoring of the system. The unit shall permit direct editing and monitoring of the application software such as programming relays, timers, counters, latches, sequences, shift registers, data transfers, PID loops, and arithmetic calculation functions. In addition, the unit shall be provided with plant process screens and allow the plant operator to monitor the facility’s process equipment, filters, pumps, blowers, etc. and start/stop equipment, set target speed for variable speed pumps, open/close monitor operated valves and adjust process setpoints as required.

2. Each PLC panel and filter console HMI shall be configured so that it will provide total control, monitoring and process displays of any process equipment within the facility as required.

3. The HMI panels shall be industrial computer-based with embedded FctoryTalk software with development and licensed with USB key. The HMI panel shall be equal to the Arison fanless PC model BO XPC-238-G00 with Arison 21.5” LCD monitor, model ADM-1821-AP and the iKay keyboard model DU-5K-TP2.

L. Operator Interface Terminal (OIT), 7-inch (RTUs 1 thru 10):

1. The RTUs at the wellss shall be equipped with an operator interface terminal for control and monitoring of the system. The unit shall permit direct editing and monitoring of the application software such as programming relays, timers, counters, latches, sequences, shift registers, data transfers, PID loops, and arithmetic calculation functions. In addition, the unit shall allow the plant operator to start/stop equipment, set target speed for variable speed pumps, open/close monitor operated valves and adjust process setpoints related to local as required. The OITs shall be Allen Bradley PanelView 700 Plus, color touchscreen.

2. The following screens shall be configured at the OITs

a. Main menu

b. One screen for each related process. The screens shall include equipment run status, HOA selector switches, open/close selector switches, process setpoints, interlocks, flow, pressure, level, analytical, and associated alarms.

c. Screens for all process setpoints.

d. Screens for last 24-hour alarms.

e. Help screen.

M. PLC Software:

1. PLC software shall consist of automatic analog monitoring logic, operator interface logic, alarm logic, and computer interfaces.

2. PLC software shall include arrangement of storage registers to hold necessary data to update displays, initiate alarms, and store comments and setpoints from the data input device. The data shall be organized to provide optimum data transmission time and system response time. To optimize network traffic and to confirm to AB recommended programming practices, programs shall use tag of user defined type (UDT). These UDT's shall consolidate PLC data into logical groups.

3. All PLC software shall be written in an easily understandable, organized manner resulting in efficient use of memory and rapid scan time.

a. The system shall be configured to ensure that all controlled variables and output signals are updated at an interval not greater than once very half-second.

N. Work Station Furniture Accessories

1. Refer to bid schedules for furniture allowances.

O. Lightning/Surge Protection

1. General

a. Lightning/surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation,

2. Signal line

a. All signal lines when they enter or leave a building shall be protected using gas tube surge arresters, and Zener diode protectors. These shall be provided at both ends of the signal lines and as close to the instruments as possible. The protectors shall be MCG type DEP or approved equal.

P. Fiber Optic System

1. Fiber optic system including the fiber optic cables, modules, connectors, and media converters shall be provided for the plant wide PLCs and RTUs network as shown on the drawings.

2. Refer to specifications section 26 05 23 03 for fiber optic systems requirements.

2.3 SYSTEM SOFTWARE

A. General

1. The system shall consist of a Microsoft, Windows , real-time operating system for process control and SCADA functions.

2. The system supplier shall provide all programming necessary to provide a fully operational system. Software required shall consist of all programs and systems necessary to perform the functions specified.

3. The contractor via the supplier shall assume complete responsibility for successful operation of system. All programs shall be completely debugged and operable prior to the delivery of the system equipment.

4. All system software shall be supplied on diskettes and shall provide fast system start-up, simple system installation, and ease of building tasks, control schemes and displays. For added security the system furnished shall include provisions for copying the contents of main memory to diskettes using single system commands. The diskettes shall then serve as a back-up for reloading the system when needed.

5. System software shall provide for addition, modification, or deletion of application detail without interruption of the processes.

6. System parameters (e.g., set points, alarm limits, and loop constants) shall be enterable or modifiable using the operator's keyboard.

7. The PLCs shall remain as the overall system coordinator. Removal of workstation computer shall not affect the operation of SCADA system except the data collection function.

8. Removal of primary FT view server computer cause the warm backup FT view server to act as primary.

B. Operating System Function Requirements

1. The operating software shall accommodate the definition of up to 128 remote PLC addresses. Each PLC address shall be capable of supporting an input combination of up to 64 digital alarm or change-of-state, up to 4 counters and up to 16 analog inputs and an output combination up to 32 digital control relays and up to 8 analog outputs.

2. The System Central Station functions and operations shall include:

a. System master display, which shall include a real-time 24-hour clock, current date, and system softkey functions.

b. East definition and editing of all system parameters shall be provided via a "fill-in-the-blanks" system definition program. All changes or additions to the database shall be easily saved to the system disk drive.

c. Individually display each of the digital and analog alarm inputs from each reporting PLC address. The report of an alarm from any monitored point shall be indicated first by the inverse video work "ALARM" accompanied by audible annunciation from an

internal beeper and then by an automatic move to the system alarm display page.

d. The alarm display page shall display each reporting remote PLC name and/or address, the name of each alarm, the time and date of the alarm occurrence, and a text message telling the operator how to respond to the situation. Each alarm display and associated annunciation shall be reset via manual acknowledgment by the operator. The beeper shall be capable of being disabled by the operator.

e. Full color user created, system status display screens shall provide the system operator the ability to view in graphic (system diagrams or schematics) or tabular form, multiple digital alarm, change-of-state, counter, and analog inputs from several remote PLC units at once. The supplied software shall be capable of supporting up to 20, user created, system status display screen showing up to 1,024 individual inputs.

C. Application Programs and Software

1. Software Package: Supply field-proven, modular software packages for data base generation; process monitoring and control; collection, analysis, storage, preparation, and printing or display of operating information for historical and managerial reports.

2. Software packages shall be process oriented and shall be assigned for use by operators who have not had any prior knowledge of programming languages.

3. Application Programs: The equipment supplier shall provide application programs to perform the following general tasks:

a. Scanning: Scanning of voltage or current inputs, pulse inputs to be accumulated, and alarm and status contact inputs. At least four analog scan rates shall be available with ability to assign any of these scan rates a point. In general, analog scan periods shall be set as follows: flow and speed every two seconds; pressure and level every five seconds; temperature and analysis every 10 seconds; a fast scan rate of at least once every second assignable for those points under computer control. Discrete inputs shall be scanned at least once every second.

1) Digital filtering shall be available via an assignable filter constant.

b. Data Conversions: Perform all data conversions to engineering units and updates of data files. In addition, perform all integration and totalization as well as any special computational requirements including signal condition, linearization, etc. Compute data from sensor-based and/or manual inputs for accumulated flows, mass flows, ratios, percentages, lab results, minimums, maximums, averages, power use, etc., and store for future retrieval and/or report generation.

c. Controls: The software package shall include in the computer the equivalent of an individual analog device, a "block." For every conventional analog "black box," there shall be an equivalent

computer "block." The software package shall provide the process engineer with the ability to logically connect blocks to achieve control schemes exactly as with analog devices.

1) The computer blocks (algorithms) shall perform a wide range of process control and calculating functions. The functions shall include, but not be limited to analog input/output, Digital input/output, Proportional-Integral-Derivative (PID) control, Ratio-Bias-Rate computations, Deadtime, Lead-Lag, High-and-Low Limit alarm detection and reporting, Switch and Auto-select branching, Logical functions, alarms, etc. Some of these functions are for future use and provisions shall be made only if at no extra cost.

d. Block functions shall include:

1) Reading and process measurement.

2) Absolute and deviation alarming.

3) Linearization/conversion to engineering units.

4) Sending an output value to the process.

5) Computational functions.

D. **Report Generation System.** The existing report generation system will be upgraded to include all equipment and system.

1. Reports formatting: Support all required logging and reporting. All logs, reports, and printouts will be free form, that is, the headings and format will be programmed and printed at time of generation. Preprinted sheets are unacceptable. Basic logs, reports, and printouts are described herein, to give system supplier a general description of the quantity, complexity, and types. Final format and variables printed shall be developed by Engineer and Owner with system supplier. Any calculations required shall be made at the time of printing. Each page of the report shall have the name of the facility, type of report, time, and date the report was prepared, and page number. All logs and summary reports, except for the alarm and equipment status logs, shall be allowed to be initiated manually and canceled from central operator's console.

2. Commands, Controls, and Set Points: The system shall be designed to enhance plant operation by centralizing the supervisory operator's activities. The operator shall have the capability of changing the values of analog signals, set points, and digital signals.

3. Plant Equipment Maintenance Scheduling Software: Provide maintenance scheduling for selected plant equipment and process units with operating time accumulation and periodic printout on the basis of either calendar or running time milestones. The software shall enable the operator to forecast and schedule maintenance tasks and alert operations when scheduled tasks are overdue.

4. The maintenance logs shall be provided for plant process equipment such as pumps, blowers, drives, generators, and any equipment, which provides "run" status signal to the SCADA system. The Plant personnel will input maintenance and frequency into the software program.

5. Real variables processing: The equipment supplier shall supply real variables to represent process data for which there are analog signal inputs to the system. System to sample each of these input signals at its selected scan rates and perform proper conversions and scaling to obtain instantaneous engineering values. These values then to be used to update real-time data on CRT displays, check for alarm conditions, and store for use with average calculations.

   a. Each hour the average of each of the variables to be calculated and stored along with the maximum and minimum values for the hour and totals where applicable.

   b. Each day the daily average value of each of the variables to be calculated and stored along with the maximum and minimum value for the day with time of occurrence, and totals if applicable. These data to be stored for at least 40 days.

   c. Instantaneous Values: Instantaneous values of all process control variable data are to be stored at the required scan rates and are to be available for use by the control algorithm at its "run" frequency.

   d. Instantaneous values of all variable data to be stored for at least one hour in resident memory. Individual one-minute averages to be used for real time trending; individual one-hour averages to be stored and used for daily reports.

   e. Variables: Variables, such as rate of flow, weight, and kilowatt usage, have their instantaneous values integrated with respect to time and the quantities totaled. Storage of each of these totals to be as follows:

      1) Current hourly total; each hourly total for 24 hours; each daily total for 40 days.

   f. Alarms: alarm conditions to be stored for up to 24 hours. In addition, an alarm description, time of occurrence, and time of return to normal also be stored. The intent is to accumulate a daily (24-hour) alarm summary for printout or display.

   g. Calculated Variables Processing: Calculated variables are to be provided to represent process parameters for which there are no direct analog inputs to the system. These variables to utilize real variables, and manually entered constants or laboratory data to compute their value. Examples of calculated variables are metering pumps where speed times known displacement integrated with respect to times becomes flow quantity in engineering units.

   h. Support Software: Support system software shall consist of utility programs which permit the operator to transfer the data from master computer into portable computer for use in or Windows operating systemwhile the system is still actively controlling the process.

   i. Security and Access: A security and access system shall be provided which will provide a method by which access to all or part of the distributed data base may be granted or restricted.

This system checks that all function requests issued from the operator's console workstation have an associated access code of sufficient authority to allow the request to be granted.

6. The system shall be capable of extracting the stored historical data into spreadsheet Excel file (provided under this contract) via DDE for further analysis and calculations for final report printing. The extraction process shall at a minimum, include the following mathematical functions: last value, standard deviation, area under survey, range, average, square root, maximum, minimum, and average for daily, weekly, monthly, and yearly reports. The final format of all reports shall be developed by the Engineer, Owner, and supplier during shop drawing process.

7. The system shall provide historical data recording of identified data points. The data file shall be user selectable as daily, weekly, monthly, or yearly for each point recorded. Each point shall have an individual enable/disable of historical recording. The historical recording shall use a compression dead-band technique to reduce the frequency and amount of data recorded when insignificant fluctuation in data occurs. The system shall utilize a preconfigured program template. The template shall allow the user an easy access and manipulation of the following: tag names, start time and date, engineering unit, color, scale, and grid.

E. Alarm System

1. The existing alarm system shall be upgraded to monitor and report all alarm conditions from new equipment and systems. Alarms and return-to-normal transition reports from the remote process controllers shall be collected at the operator's console. Upon receipt of these alarm reports, the console shall perform several automatic operations, which provide an interface for allowing the operator to interact with these alarm conditions.

2. Alarm classes shall be established at system configuration for those analog or logical signals that are assigned alarm limits, marginal or failed communication link and failure of a hardware device such as CRT, printers, input/output module or other major devices. The alarm system will have three classes of alarms: critical, non-critical, and process.

3. An audible alarm shall be activated whenever the operator's console receives an alarm report that must be acknowledged by the operator. To silence the audible alarm, the operator depresses the audible silence function key on the workstation keyboard. Silencing the alarm, however, does not constitute alarm acknowledgment.

4. All alarm conditions and equipment status residing at servers database shall be extracted for monitoring and recording at SCADA computer.

F. Real-time Trending. Upgrade trending displays to include new equipment and systems.

1. Real-time trend displays shall plot samples of the selected points in an x-y format. A trend page shall consist of at least four trend plots with each plot using its unique color. The user shall be able to request exact numeric values for any point in the trend by moving an arrow to the point in the graphic.

2. Trends shall be offered in line, bar, and text form.

3. Provisions shall be made so that the points and scan frequency shall be assignable by the operator from display.

4. All analog signals stored at SCADA database shall be extracted for monitoring and trending at SCADA computers. Minimum, maximum, and average values for hours, daily, or weekly trends shall be provided as required.

G. Historical Trending. Upgrade trending displays to include new equipment and systems.

1. Provision shall be made for storing historical data and to recall that data on CRT for historical trending and display purposes.

2. Capability to average values to permit longer trending periods shall be provided.

3. A trend page shall consist of four trend plots with each plot using its unique color.

4. The signal, its remote name, as well as maximum, minimum, and engineering units shall be displayed.

H. Display System. Displays will include all process equipment and systems.

1. The system shall be designed to provide for the display of process graphics. These displays shall be the primary means by which real time process information shall be presented to the operator at the operator's console. The displays shall be generated by collecting data from throughout the plant and the PLCs.

2. The displays of process graphics are to be configured during the shop drawing phase of the work in conjunction with the owner and the engineer.

3. All graphic pictures and characters must be editable by the operator from the operator station while the system remains online. Graphic pages shall be called to the screen by their number, name, or from a menu of available pages.

4. Graphic editor must be menu driven, and contain standard geometric symbols such as lines, circles, rectangles, etc., making creation, modification, and copying of graphics a simple task. A mouse interface for the graphics editor shall be optional.

5. An alarm history display shall be provided which allows the operator to examine the current alarm conditions throughout the entire system. All alarms shall be logged on the alarm printer when they are received, and when they return to normal.

6. The alarm system shall execute three operations whenever an alarm report is received.

a. An audible alarm shall be actuated if the alarm report must be acknowledged by the operator.

b. Alarms with a priority of "critical," "non-critical," or "process" shall be added to the alarm history buffer.

7. All alarms are logged on the alarm printer. Alarm information shall be conveyed by changing color of the single value as follows:

a. Flashing Green: Unacknowledged Normal

b. Steady Green: Acknowledged Return to Normal

c. Flashing Red: Unacknowledged Alarm

d. Steady Red: Acknowledged Alarm

e. The most recent alarm reports in the alarm history file shall be presented on the CRT.

8. The following custom graphics screens shall be configured as a minimum in addition to those required by the system:

a. One screen to present the water treatment facility overall process to allow the operator to view the complete plant process on a single display. Individual process schematics shall be indicated with a separate graphic. These displays shall be accessible through poke points on the process override display. Each display shall depict all elements involved in that particular process area (i.e., pumps, valves, flows, levels, set points, etc.)

b. One screen for raw water flow process including flow rate at each well, modulating valve status, filter influent water lever, clearwell level, and effluent flow rate.

c. One screen for filter status of filters status, including number of in service, backwash, ready for service, out of service, water quality controls at filter, influent water level, influent flow rate, effluent flow from each filter, turbidity, and flow from each filter, etc.

d. One summary screen for high service pumps. The screen shall include:

1) Pump symbol and process piping.

2) Pump status of each pump (H-O-A and Lock Out).

3) Valve positions status of Check Valve and Isolation Valve

4) Pump fail.

5) Pumps run time.

6) Pump software HOA selector switch.

7) Pump control setpoints.

8) Pump interlocks and override switches.

9) Tank levels in clearwell

10) Pump chamber level.

11) Vacuum priming valve alarm.

12) Motor temperature

13) Pump High Pressure Alarm

e. One screen to present the water treatment facility overall process to allow the operator to view the complete plant process on a single display. Individual process schematics shall be indicated

with a separate graphic. These displays shall be accessible through poke points on the process override display. Each display shall depict all elements involved in that particular process area (i.e., pumps, valves, flows, levels, set points, etc.)

f. One screen for Raw Water Influent Control Valves and Influent Flow Meter, indicating Pump status, Water Level in Well, Flow rate at each pump, Pressure in discharge of pump, alarms, etc.

g. One screen for well station (1 thru 10) including well, Pump status, VFD speed and status, Water Level in Well, Flow rate at each pump, Pressure in discharge of pump, alarm setpoints, alarms, etc.

h. One screen for each pair of filters (2 pairs of filters) including, but not limited to: influent flow, effluent flow, head loss, level, turbidity, backwash and surface wash status, remaining cycle time, and related valve's position status, effluent valve PID controls, piping, etc.

i. One screen for the high service pump chambers level, including but limited to: level and related valves. Setpoints for pump control and alarms, volume, etc.

j. One screen for the backwash controls including, but not limited to: flow rate, valve controls with software PID controller, status, etc.

k. One screen for backwash and backwash waste pump, and backwash holding lagoon levels, totalized backwash flow alarm setpoints, volume, pump status, etc.

l. One screen for influent flow control modulating valve, including but not limited to: flow rate, modulating valve software PID controller and related valve status, alarms, and setpoints for control and alarms, etc.

m. One screen for each type chemical process (chlorine, fluoride, etc.) used at Northwest WTP including but not limited to: tank levels, analytical signals, related pumps, valves, piping, etc.

n. One screen for plant electrical system including but not limited to: plant electric energy usage, demand, standby power status, etc.

o. One screen for Water Quality Reporting that includes summary of real-time, daily average, maximum and hourly flows, average, min, max and real-time analytical data, daily filtration rates, total daily volumes per filter, backwash water total daily volume, effluent flows from each filter, effluent flow meter, etc.,

p. One screen for each chemical Storage and Feed System, including but not limited to: tank levels, analytical signals, related pumps, status, alarms, valves, piping, etc.

q. One screen wellfield status graphical display screen that depicts the instantaneous flow rate in gallons per minute from each

pump 1, 2A, @B, 3, 4, and 7) and the Raw Water Flow Rate and Effluent Flow Rates, Raw Water and Effluent Pressures, and Analytical Reading for Effluent Chlorine Residual, pH, and Turbidity, and Particle Count in the effluent discharge. The information displayed shall include Pump status for all Wellfield pumps, High Service Pumps, Backwash Pump, and Filter to Waste Pump, including, (Running ON, OFF, Out of Service).

r. Ten additional screens for plant miscellaneous process and non-process systems as determined during shop drawing process.

s. Five system help screens. One shall be an operator help display that provides a summary of basic keyboard functions designed to prompt an operator regarding system access and control. The second shall be a supervisor help display that provides a listing of commands to allow alarm, trending, and display modifications.

t. PLC status displays: These displays shall show the PLC and depict operational status of each module within the PLC throughout the system.

u. Communication link status displays: This display shall provide communication statistics alongside a pictorial representation of each communication link.

v. Each graphic display shall be provided with dynamic symbols to present equipment symbol and status (run, off, fail) process variables (flow, level, pressure, speed, analytical, etc., in engineering unit provided with flow control valve, gauge pressure, wet well, etc., symbols), control setpoints, analog limits, process and non-process alarm. In addition, system shall have the ability to print selected graphic displays including graphic symbols and parameters.

w. Preconfigured control displays for pump control, pump alternation and time of day control shall be provided for the new equipment controlled from the SCADA system. As minimum the displays shall include the following: H-O-A local/remote control, start/stop setpoints, start/stop/fail over-ride, run time process variables (volume, totalization, etc.). Control displays shall be presented in a separate window allowing quick access while all other programs continue execution.

x. Alarm trending and log displays as specified herein.

y. One screen for process interlocks and override functions.

z. Copies of existing distribution screens to the new system.

aa. Screens for pager alarms.

bb. Screens for control and alarm setpoints.

cc. The final format and orientation of graphic displays shall be developed between ENGINEER, OWNER, and SYSTEM INTRGRATOR during software shop drawing process.

PART 3 EXECUTION

3.1 INSTALLATION

A. **Prior to all work** of this section, carefully inspect the existing facilities, and install work of all other trades and verify that all such work is complete to the point where installation may properly commence.

B. **The equipment shall** be installed in accordance with the manufacturer's instructions and located as shown on the drawings, or as approved by the engineer. Local electrical shutoffs for power supplies to equipment shall be provided.

C. Discrepancies

1. In the event of discrepancy, immediately notify the engineer.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

D. **The control system** and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the drawings or as approved by the engineer.

E. **It shall be the responsibility** of the manufacturer of this section to ensure compatibility with existing system. If additional equipment or wiring is necessary, it shall be done at no cost to the owner.

3.2 MANUFACTURER'S SERVICES

A. **The contractor shall** furnish the services of the manufacturer's serviceman, all special tools, calibration equipment and labor required for the following:

1. Checking the installation of all components before power is applied.

2. Placing the software and hardware into operation and making necessary adjustment.

B. **Should the equipment fail** to operate in accordance with the specifications and manufacturer's data, corrective measures shall be taken by the contractor or the defective equipment shall be removed and replaced with equipment which will satisfy the specified conditions.

C. **When all required approvals** of this portion of the work have been obtained, and at a time designated by the owner, thoroughly demonstrate to the owner's maintenance personnel the operation and maintenance of all items installed under the work of this section.

3.3 INSPECTION

A. **Installation.** Supervision and assistance to ensure that proper procedures are followed during installation of the system.

B. **Start-up.** Energize and verify correct and satisfactory operation of all components of the system. This operation shall include verification of the accuracy of all inter-equipment wiring.

C. **Subsystem Commissioning.** Place into operation all component subsystems. This operation shall include loading and placing into operation all CPU software and calibration of all system inputs and outputs. Simulation of system inputs and outputs that are not operational during this subsystem commissioning phase shall be allowed, provided that all of these simulated inputs/outputs shall be subsequently verified during the system commissioning operation.

D. **System Commissioning.** Calibrate and place into operation the complete system. The validity of all data base information in the system shall be checked and corrected as part of this operation. Calibration of all process control loops external to the equipment being supplied by other equipment suppliers will be the responsibility of the contractor prior to system commissioning.

3.4 Additional Programming Services and TESTING Equipment

A. **Additional Programming Services**. Under Contract E – Electrical and I&C, the Electrical Contractor will include the cost for providing the services of the System Integrator to provide additional programming services to change/modify the application programs described in the functional description. These services shall be excluded from those required by the contract specifications. The System Integrator shall be responsible to provide all necessary SCADA hardware, software, and installation to provide a fully operational system as specified herein.

B. **Electrical Testing Equipment and Tools** – Under Contract E – Electrical and I&C, the Electrical Contractor, to include the cost of additional testing equipment and tools required to maintain, test, analyze, and calibrate instrumentation and controls provided under this contract by equipment manufacturers, vendors, equipment suppliers, contractors, or the system integrator. The Contactor shall procure, ship F.O.B. (Jobsite), and unload additional test equipment and tools identified by the Owner or Engineer. All work will be authorized in advance, and any unused allowance will be deducted from the total amount of the contract at the completion of the project.

3.5 SYSTEM INTEGRATOR

A. **Pre-Qualified System Integrators.** Subject to compliance with these requirements, the instrumentation system process control System Integrator shall be one of the following:

1. Dublin Tech
2. Dmytryka Jacobs Engineers
3. RoviSys Building Technologies
4. Commerce Controls Inc.

B. **BASE BID:** This bid represents the fourth phase of work for constructing a new SCADA system that will service three plants and remote facilities. Therefore, to System Integration Work minimize costs and achieve standardization of equipment, programming, and configuration of the SCADA hardware and software, the City has elected to nominate Dublin Controls Systems Corporation as the basis of bids for this work.

3.6 ALTERNATES TO THE BASE BID FOR SYSTEM INTEGRATION:

A. The Bidder shall use the price provided by Dublin Control Systems Corporation, Columbus, OH as the basis of their base bid price. As an alternate, the bidder may also enter in a bid to provide system integration services using the authorized system integrators listed above, and/or an alternate supplier. The bidder may offer the alternate at no additional cost or provide an add or deduct price relevant to the base bid price.

B. Any alternate not listed as preapproved on the Bid Form must submit a complete qualifications package to accompany the Bid Forms. The alternate price shall

meet the requirements of the specifications, and the system integrator will be responsible for providing all labor, materials, equipment, and tools to furnish, install, integrate, fabricate, assemble, install, calibrate, test and commission, and train City Operators and Maintenance staff on the instrumentation and control systems incorporated into the SCADA system The bid package will be reviewed during the bid evaluation process and a determination will be made by the ENGINEER AND CITY regarding the alternate bid offer.

C. Basis of Contract - If the Alternate Bid is deemed to be inadequate due to scope, quality, expertise, experience, and references provided by the System Integrator for work on similar projects, or for any reason determined by the City to be unacceptable, the Electrical Contractor must utilize base bid System Integrator, Dublin Technical Systems.

END OF SECTION

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SECTION 40 95 33.06

NETWORK EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract apply to this section.

B. **Related Sections**

1. Section 40 90 00, "Instrumentation Systems Basic Requirements."
2. Section 26 00 01, "Basic Electrical Requirements."

1.2 DESCRIPTION OF WORK

A. **General**. Provide the labor, tools, equipment and materials and provide the assembly, testing, and start-up services required to provide a complete and operational Local Area Network (LAN) system as specified and shown on the Drawings. The system includes, but is not necessarily limited to, the plant information and data network Ethernet switches, associated enclosures, and appurtenances.

B. **Types**. The types of equipment specified in this section include the following:

1. Lean managed Ethernet switch.
2. Managed Ethernet switch.

C. **System Description.**

1. The work generally consists of the following:

a. Provide and install a connection and interface to a plant-wide LAN. Physically configure the system as shown on the Drawings, to provide communications to the system servers, workstations, PLCs, and other equipment as indicated on the Drawings.
b. Provide all communications and networking devices (switches, routers, modems, interconnecting fiber and copper patch cables, power supplies, UPS) and other appurtenances as shown on the Drawings, specified in the Contract Documents, or required as a part of a good installation practice.
c. Provide SNMP (Simple Network Management Protocol) based network equipment that can be monitored and controlled from a central network management computer. Provide manufacturer's recommended monitoring and configuration software and cabling for managing the LAN equipment.

2. Topology

a. Fiber-optic multi-mode cabling shall provide connection between area switches.
b. 10/100Base-T copper Category 5e (Cat-5e) cabling shall provide connection between area switches and other network devices, as shown on the Drawings.

3. The Contractor is responsible for providing all labor, any necessary cables, connectors, converters, adaptors, and software products needed to install, calibrate, test, adjust and place into service a complete and fully operational plant-wide LAN system.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with applicable requirements of governing agencies having jurisdiction.

1. National Electrical Manufacturers Association (NEMA) Compliance.
2. National Electrical Code (NEC) Compliance.
3. Underwriters' Laboratories, Inc. (UL) Compliance and Labeling. Comply with provisions of UL safety standards pertaining to instrument control panel equipment. Provide components which have been UL listed and labeled.
4. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional applicable codes and standards.

B. **Qualifications**

1. Manufacturer's Qualifications.

a. Firms regularly engaged in the manufacture of communications equipment whose products have been in satisfactory use in similar service for at least 5 years.

2. Installer's Qualifications.

a. Firm with at least 5 years of successful installation experience on projects with materials and equipment similar to items specified herein.

1.4 SUBMITTALS

A. **General**. Furnish manufacturer's product data, test reports, and materials certifications as required. See Section 40 90 00, "Instrumentation Systems Basic Requirements," for additional submittal requirements.

B. **Materials List**. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.

C. **Wiring Diagrams**. Submit wiring diagrams showing all connections for all equipment furnished or installed under this section.

1.5 **JOB CONDITIONS**. Refer to Section 40 90 00, "Instrumentation Systems Basic Requirements."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Storage and Protection**. Store the items furnished under this section in such a manner that meets the requirements of the manufacturer and is approved until they can be installed. Use all means necessary to protect the material of this section before, during, and after installation, and to protect the installed work and materials of all other trades.

1.7 **SPECIAL WARRANTY**

A. **General**. Retain the services of factory-trained servicemen to provide repair services, including all repair and replacement parts needed during warranty period, for communications equipment for 1 year commencing with the time the system equipment is complete and accepted.

PART 2 - PRODUCTS

2.1 **MANUFACTURED UNITS**

A. **Lean Managed Ethernet Switch**

1. General: Provide an Ethernet switch for segment connection of the network backbone to the area PLCs, operator interfaces and workstations, and other equipment as shown on the Drawings.

2. Features.

a. Lean managed Compact switch with 8 ports, 4 RJ45 and two SC multimode fiber optic ports.
b. 10/100 Mbps RJ45 ports (10Base-T/100Base-TX) with auto crossing and auto negotiation.
c. Glass fiber SC ports 100 Mbps (100Base-Fx)
d. IGMP and multicast filtering.
e. Management via standard SNMP.
f. Integrated web server for configuration and diagnostics.
g. Status and diagnostic indicators on the devices.
h. Rapid Spanning Tree protocol (IEEE 802.1w).
i. V.24/RS 232 Communications interface.
j. 24 VDC voltage supply.

3. Manufacturer.

a. Subject to compliance with the requirements of this specification, provide lean managed Ethernet switch manufactured by the following or approved equal:

1) Phoenix Contact Lean Managed Switch.

2) NTRON.

B. **Managed Ethernet Switch**

1. General: Provide an Ethernet switch for segment connection of the network backbone to the area PLCs, operator interfaces and workstations, and other equipment as shown on the Drawings.

2. Features.

a. Managed Compact switch with 16 ports, 14 RJ45 and two SC multimode fiber optic ports.
b. 10/100 Mbps RJ45 ports (10Base-T/100Base-TX) with auto crossing and auto negotiation.
c. Glass fiber SC ports 100 Mbps (100Base-Fx)
d. IGMP and multicast filtering.
e. Management via standard SNMP.
f. Integrated web server for configuration and diagnostics.
g. Status and diagnostic indicators on the devices.
h. Rapid Spanning Tree protocol (IEEE 802.1w).
i. V.24/RS 232 Communications interface.
j. 24 VDC voltage supply.

3. Manufacturer.

a. Subject to compliance with the requirements of this specification, provide lean managed Ethernet switch manufacturered by the following or approved equal:

1) Phoenix Contact Managed Switch
2) NTRON Managed Switch.

PART 3 - EXECUTION

3.1 **INSTALLATION**. Install equipment as indicated, in accordance with manufacturer's written instructions and with recognized industry practices.

A. **Examination**

1. Verification of Conditions. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that the work is complete such that this installation may commence.
2. Discrepancies. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation until all discrepancies have been resolved.

B. **Preparation**

1. Protection.

a. All equipment and materials shall be packed at the factory to protect each item from damage during shipment and storage.

b. Provide blocking and cushioning materials to prevent damage during shipment.
c. Provide temporary lifting lugs on shipping package as needed.

2. Surface Preparation. The work shall be carefully laid out in advance. Any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, and at no additional cost to the Owner.

3.2 FIELD QUALITY CONTROL

A. Testing

1. After all input and output connections are made, the switches shall be dry tested for proper operation by simulating fault conditions at the input terminals of the LAN equipment. Any malfunction or error in the designed performance shall be corrected. The Contractor shall check the operation after all LAN devices have been wired by manually activating the input devices via testing devices simulating network traffic.

B. Manufacturer's Field Services:

1. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in start-up of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the Contractor in testing the assembly and components contained herein.

2. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

3.3 DEMONSTRATION

A. **General**. When all required tests have been performed, and prior to final approval, a qualified representative of the supplier shall thoroughly demonstrate to the Owner's personnel the operation of all items installed under this section in accordance with Section 40 90 00, "Instrumentation Systems Basic Requirements."

END OF SECTION

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SECTION 41 22 23.13

BRIDGE CRANES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Division 26, Section 05 10 00 "Structural Steel", Section 05 00 00 "Grating and Miscellaneous Metals", Section 09 90 00 "Painting", and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the bridge cranes complete and operational.

1. The Work includes:

a. Single-girder, top running bridge cranes with under- running electric wire-rope hoist and trolley.

b. Pendant operated controls.

c. Bridge and trolley electrification systems.

d. Rails, splice bars, rail clips, stops, fasteners, and all other appurtenances required for complete and operational bridge crane systems.

e. Installation of new stops to avoid conflicts with existing and proposed equipment as shown on Contract Drawings. The stop on the east side, near Column Line E, shall be place to avoid the proposed stairs. Specific location of all stops for the bridge crane shall be coordinated with the Owner and Engineer.

1.3 QUALITY ASSURANCE

A. **Codes**. Perform all work in compliance with all federal, state and local codes.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ANSI/AGMA 6013-A, Standard for Industrial Enclosed Gear Drives.

2. ASME B30.16, Overhead Hoists (Underhung)

3. ASME B30.17, Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)

4. ASME HST-4, Performance Standard for Overhead Electric Wire Rope Hoists

5. ASTM A36/A36M, Specification for Carbon Structural Steel

6. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 KSI Minimum Tensile Strength

7. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

8. ASTM A992/A992M, Specification for Structural Steel Shapes.

9. AWS D 1.1, Structural Welding Code - Steel

10. AWS D 14.1, Specification for Welding of Industrial and Mill Cranes Other Material Handling Equipment

11. CMAA 74, Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist

12. NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities

13. SAE J429, Mechanical and Material Requirements for Externally Threaded Fasteners

14. HMI - Hoist Manufacturers Institute

15. AGMA -Standards of American Gear Manufactures Association

16. OSHA – Occupational Safety and Health Administration

17. NEC – National Electric Code, Article 610, Cranes and Hoists

C. **Regulatory Agencies**. All equipment furnished shall, unless otherwise specified, conform to standards of the following organizations:

1. OSHA – Occupational Safety and Health Administration

2. Crane Manufacturers Association of America, CMAA

3. Hoist Manufacturers Institute, HMI

D. Components Safety and Compatibility

1. The bridge crane equipment manufacturer shall review and approve or shall prepare all Submittals for all components furnished under this Section.

2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the hoist equipment manufacturer.

E. Qualifications.

1. Manufacturer.

a. Equipment furnished under this Section shall be a standard product of the manufacturer.

b. Minimum of five years of experience producing substantially similar equipment and shall be able to furnish documentation of at least five installations in satisfactory operation for at least five years in the United States.

c. Equipment shall be manufactured in the United States

2. Installer.

a. Engage to perform the Work under this Section an installer experienced in installing bridge crane equipment similar to that required for the Project and is acceptable to bridge crane manufacturer.

b. Submit name and qualifications, and the following information for at least three successful, completed projects:

1. Names and telephone numbers of each owner and architect or engineer responsible for project.
2. Approximate contract cost of bridge crane work.
3. Number of installations.

F. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of component manufacturer from a single bridge crane manufacturer.
2. Bridge crane manufacturer shall review and approve or prepare all submittals for components furnished under this Section.
3. Components shall be specifically constructed for the specified service conditions and shall be integrated into overall equipment assembly by bridge crane manufacturer.

1.4 SUBMITTALS

A. **Product Data**. Manufacturer's product data in accordance with Section 01 33 00, “Submittals” shall be submitted to the Engineer for review.

1. Manufacturer’s literature, illustrations, specifications identifying the materials of construction, rated capacities, dimensions of individual components, and finishes.
2. Make, model, weight and horsepower of each component.
3. External power requirements for each component.

B. **Shop Drawings**. Submit shop drawings for approval. Shop drawings shall be in accordance with Section 01 33 00, “Submittals” and shall include:

1. Complete description of materials and equipment in sufficient detail to allow comparison with requirements of this Section.
2. Manufacturer’s certified clearance diagram showing arrangement of system dimensions, and required clearances including plan and sections.
3. Maximum wheel loads.
4. Weight of hoist and trolley.
5. Maximum support reactions.
6. Specialized wiring diagram for all electrical equipment.
7. Warranty.
8. Testing plans: Plan for load testing at the site.

C. Informational Submittals. Submit the following:

1. Certificates:
   a. Affidavits of compliance with referenced standards and codes.
   b. Manufacturer’s installation certification.
2. Manufacturer's Instructions:
   a. Special shipping, storage and protection, and handling instructions.

b. Routine maintenance requirements prior to start-up.

3. Field Quality Control Submittals:

a. Load test report, including copy of certifications of test weights.

4. Manufacturer's Reports: Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.

5. Qualifications Statements: Manufacturer and installer qualifications shall be provided when requested by the Owner/Engineer.

D. **Operation and Maintenance Manuals**. Submit operation and maintenance (O&M) manuals in accordance with Section 01 33 00, "Submittals". Submit the initial review copy of the O&M manual and six revised copies prior to delivery of the equipment.

E. **Personnel Qualifications**. Submit qualification statements, in accordance with Section 01 33 00, "Submittals", of all manufacturer's representative personnel that will be servicing the equipment with the six revised copies of the O&M manuals.

F. **Manufacturer's Representative Reports**. Submit manufacturer's representative reports within 48 hours of each site visit. Include product and material certifications, and inspection data as specified in Section 01 33 00, "Submittals", with this report(s).

G. **Test Report**. Submit test reports within 48 hours of completion, suspension, or termination of testing the bridge crane systems under all design conditions.

1.5 JOB CONDITIONS

A. **Coordination with Other Work**. Coordinate the scheduling of the work and the location of equipment with other trades to prevent delays, errors, and/or omissions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. Deliver, store, and handle the bridge crane in accordance with Section 01 60 00, "Materials and Equipment" and the manufacturer's instructions.

B. **Acceptance at Site.** Inspect all equipment and materials against reviewed Shop Drawings at time of delivery. Equipment and materials damaged or not meeting the requirements of the approved Shop Drawings shall be immediately returned for repair or replacement.

C. **Storage and Protection.** Carefully prepare for storage and label all equipment and materials after they have been inspected. Store all equipment and materials in a dry, covered, ventilated location and protect from harm according to the manufacturer's instructions.

D. **Packing, Shipping, Handling, and Unloading.** Deliver materials to the Site to ensure uninterrupted progress of the work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of work.

1.7 SPECIAL WARRANTY (Not used.)

PART 2 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:

1. The bridge crane shall conform to headroom, hook elevation, and side clearance requirements shown and indicated in the Contract Documents and shall provide required available lift height and capacity.

2. Electrical equipment and controls shall conform to applicable NEMA requirements for the equipment environment specified in the Contract Documents.

B. **Performance Criteria.** See Schedule in Part 4

C. **Manufacturers**. Subject to compliance with the specifications:

1. The bridge crane, hoist, and trolley shall be as manufactured from one of the following approved manufacturers with specified accessories or features.

a. ACCO Industries Inc.

b. Yale

c. Approved Equal

2. The manufacturer of the push-button controls for motor-driven units shall be Allen Bradley, Telemecanique, Magnetek, Conductix, Duct-O-Wire or approved equal.

2.2 DETAILS OF CONSTRUCTION

A. General Requirements.

1. Provide runways, bridge crane, trolley, and hoist that meet the design critical requirements as specified herein and as shown on the Drawings.

2. Clearances.

a. Give special consideration to available headroom and vertical clearances. Minimum overhead clearances shall be 1’-4”

b. Side clearance. Provide a minimum side clearance of 12 inches to building walls and 3 inches to all building infrastructure.

c. End clearance. Provide a minimum clearance of 3 inches between ends of runways and building walls.

3. Crane Runways. Provide standard structural steel shapes or manufacturer’s standard. Crane runways shall be installed as shown on the Drawings and shall include all necessary support bracing, type 316 stainless steel fasteners, and appurtenances.

4. Brakes. Provide a braking system with ample thermal capacity for its class of service.

5. Comply with applicable provisions of CMAA 70 or CMAA 74, and ASME B30.2, ASME B30.16, and ASME B30.17, as applicable to the equipment provided.

6. Design Stresses: Load suspension components shall be constructed so that stresses at rated load do not exceed 20 percent of material’s average ultimate strength.

7. Shop welding shall be in accordance with AWS D14.1.

8. Give special consideration to available headroom and vertical clearances.

9. Provide bridge crane with configuration and weight that does not result in load exceeding design capacity of bridge crane runway beams.

10. Include impact allowance in design calculations for trolley, bridge, and end- trucks. Impact allowance shall be 1/2 percent of rated load for each foot per minute of hoisting speed with minimum allowance of 15 percent and maximum allowance of 50 percent.

11. Incorporate into equipment provided safety requirements in accordance with ASME B30.2, ASME B30.16, and ASME B30.17, as applicable to the equipment provided.

B. Electric-powered Wire Rope Hoists.

1. Comply with ASME B30.16 and ASME HST-4. Welding shall comply with AWS D14.1.

2. Load Blocks: Load blocks shall be enclosed type, constructed to prevent rope jamming.

3. Hooks: Provide latch-type hooks, free to rotate through 360 degrees under all loading conditions. Hooks shall be heat-treated drop forged steel.

4. Hoisting Rope: Rated load shall be based on factor of safety factor of five (5) on rope's nominal breaking strength. Attach rope ends to hoist drum to prevent rope from coming off drum on full extension. Rope shall be extra- flexible improved plow stainless steel with hemp core.

5. Rope Sheaves: Sheave grooves shall be smoothly finished to close, form-fitting saddle for rope with sides of groove tapered outward. Provide running sheaves with means for lubrication. Pitch diameter of sheaves shall not be less than 16 times rope diameter for running sheaves, and for non- running sheaves not less than 12 times rope diameter.

6. Drum: Rope drum diameter shall not be less than 18 times rope diameter. At least one complete wrap of rope shall remain on drum after rope's full rated extension.

7. Hoist shall be true vertical lift.

8. Gearing: Machined and heat-treated. Hoist gear box shall be in accordance with AGMA 6013-A. Provide means for adequate lubrication of gearing.

9. Hoist Brakes: Breaking system shall consist of break and control breaking means, and shall perform the following functions under normal operating conditions both with rated load and under test conditions with 125 percent of rated load:

a. Stop and hold the load when controls are released.

b. Control the load during lowering to maximum speed of 120 percent of rated lowering speed for load being handled.

c. Stop and hold the load during a complete power failure.

d. Breaking system shall have heat dissipation capability for frequency of operation required by hoist duty cycle classification.

e. Breaking system shall have provision for adjustments to compensate for wear.

10. Provide an overload protection device that prevents lifting of loads beyond rated capacity.

11. Motor: Specifically constructed for reversing and hoisting service and capable of operating at specified loads.

    a. Motor shall be heavy-duty, thermally protected, 30-minute rated, H4 duty classification. Motor at rated frequency shall be capable of operation at plus or minus ten percent of rated motor voltage.

    b. Provide totally enclosed, squirrel cage, Class F insulation, high slip, high torque.

    c. Horsepower - Rating with service factor of minimum 1.00 shall equal to the duty requirements at all operating points.

    d. Provide reversing contactors with automatic reset thermal overloads.

    e. Electric Power: 460 VAC, 60 Hz, and 3 Phase.

    f. All wiring and equipment shall comply with the provisions of Article 610, National Electric Code.

    g. Bridge Crane Motors: TENV, squirrel cage, Class B insulation, 55-degree C temperature rise, high slip, and high torque.

    h. Trolley Motor: TENV, squirrel cage, Class B insulation, 55-degree C, high slip, and high torque.

    i. Hoist Motor: TENV, squirrel page, Class F insulation, 75-degree C temperature rise over a 40-degree C ambient temperature, 2 speeds, high slip, high torque. Furnish with a solenoid operated motor brake.

12. Hoist shall contain upper and lower limit switches to limit hook travel.

13. Housing and Covers: Cast aluminum.

14. Provide supports, fasteners, brackets, and all accessories required.

15. Runway Rail Stops:

    a. Design to withstand the horizontal load produced by the crane. Crane manufacturer shall supply bumpers with sufficient energy absorbing capacity to absorb the horizontal impact load on runway stop.

16. Anti-sway bracing of structural steel is required at each suspension point on underhung cranes (1 runway beam only) to limit the sway of the flexible supports to 5 degrees in both the lateral and longitudinal system. All runway systems must be aligned and leveled before anti-sway bracing is installed. The bracing shall not carry any of the vertical load.

a. Fasten anti-sway bracing assemblies to structure/ceiling as shown on the Drawings.

17. Impact Allowance. Provide an impact allowance of 0.5% of the rated load for each foot per minute of hoisting speed with a minimum allowance of 15% and a maximum of 50%.

18. Safety Requirements: Comply with the requirements of ASME B30.11, Safety Requirements for Monorails and Underhung Cranes, for all equipment furnished under these specifications.

19. Bridge Beam: A-992, Standard Specification for Carbon Structural Steel.

20. Provide a crane with a configuration and weight that does not result in a load exceeding the design capacity of the runway beams. The runways shall be designed for a maximum static load of 3,000 pounds, including impact allowance, at crane bridge corner loads when end truck wheel spacing is as required in the Schedule in Part 4.

21. Electrical Equipment: Conform to the provisions of Article 610, National Electric Code and Division 26.

a. All enclosures shall be NEMA 4X stainless steel with latches (screws will not be accepted). All hardware on these enclosures, hinges, pins, clamps, nuts, bolts, washers, etc., shall be stainless steel. Enclosure doors shall be hinged with print pocket.

C. Electric-powered Trolleys.

1. Wheels. Fabricated of heat-treated drop forged steel. Wheels shall have uniform surface hardness and capable of carrying maximum applied load.

2. Trolley motor shall be thermally protected.

3. Gearing. Machined and heat-treated. Hoist gear box shall be in accordance with AGMA 6013-A. Provide means for adequate lubrication of gearing.

D. Crane Bridge.

1. Bridge Girders: ASTM A992, structural steel.

2. Maximum Deflection: 1/600 of bridge span at rated load.

3. Provide rubber stops on ends of bridge girders and ends of runways.

E. Bridge End-trucks.

1. Fabricate of structural steel shapes.

2. Wheelbase of end-truck shall be 1/8 of span or greater.

3. Lugs shall be provided on end-trucks to limit drop of end-truck to one-inch or less in the event of wheel or axle failures. Provide rail sweeps in front of each outside wheel, projecting below runway rail.

4. Wheels: Double flanged, and of drop forged or rolled steel.

a. Minimum Tread Hardness: 200 Brinell.

b. Bearings: Pre-lubricated and sealed, or provided with fittings and seals for pressure lubrication.

F. Crane Runway Rails.

1. General. Contractor shall furnish all labor, equipment, and tools to remove existing hoist, trolley, bridge crane, and runway rails and dispose of offsite.

2. Provide runways with tight end joints suitable for crane service with joint bars matching the runways sections, joint bar bolts and nuts complying with ASTM A325 with AREMA alloy steel spring washers, and fixed or floating type rail or J-bolt clamps, as required to suit the conditions shown.

3. Runways shall be level and shall not vary in span measurement by more than plus or minus ¼ inch at any point along the runway.

4. Miscellaneous. Runway end stops, expansion connections at the building expansion joints, and sections adjoining hardware shall be included. Maximum space between sections shall be 1/6 of an inch.

2.3 CONTROLS FOR ELECTRIC HOIST AND TROLLEY

A. Hoist Speed Control:

1. Hoist motor shall be single-speed or dual-speed, as specified in the Schedule in Part 4, with magnetic control.

2. Each magnetic control shall have contactors sized for specified service class. Reversing contactors shall be mechanically and electrically interlocked to prevent line-to-line faults and shall be provided with automatic reset thermal overloads for hoist motor.

B. Trolley Speed Control

1. Operation. Trolley shall be electric operated self-centering travel and have flat tread wheels matched to the monorail.

2. Trolley shall be provided with a variable frequency drive to provide speed not greater than 30 feet per minute (fpm) and come complete with electric holding brake and solid-state acceleration control module. Control module shall provide soft acceleration and deceleration to prevent load swing by trolley movement. Adjustments for acceleration and starting torque shall be provided.

C. Control Station:

1. Control station shall be rated in accordance with the Schedule in Part 4. Motion control pushbuttons shall spring return to “Off” position when released. Clearly mark function of each pushbutton and indicate direction of resultant motion.

a. Control station shall contain the following functions for single-speed hoists:

1. “Power On”

2. "Power Off”

3. “Raise”

4. “Lower”

5. “Trolley - East”

6. “Trolley - West”

7. “Bridge - North”

8. “Bridge - South”

2. Pendant Control: Control of hoist, trolley, and bridge shall be by pendant pushbutton control station.

a. Pendant mounting shall include galvanized steel cable to provide strain relief for pendant’s electric control cable. Provide isolating transformer to reduce voltage to 24 volts (or less) in control circuits.

b. Mount control pendant and cable on 12-gage galvanized steel C-track festoon system that allows hoist and trolley to move independently of Control Station.

2.4 ELECTRIFICATION

A. C-Track Festoon:

1. Provide power cable on 12-gage galvanized steel C-track festoon system.

2. System Components: Electrification system shall include, but is not limited to the following:

a. C-track

b. Track hangers.

c. Cable carriers.

d. Lead carrier.

e. End stop.

f. Splices.

g. Clamps.

h. Cable and connectors required for power and control connections.

B. **Manual Safety Switch:** Electrical Contractor under Contract B shall provide manual safety switch to disconnect power to bridge crane.

2.5 FINISHING

A. Surface Preparation and Painting:

1. Surface preparation and shop painting is required for ferrous metals, equipment, and accessories. Do not paint stainless steel and machines surfaces.

2. Clean and apply in the shop prime coat in accordance with Section 09 90 00, Painting.

3. Apply in the shop finish coat in accordance with Section 09 90 00, Painting.

4. Paint the bridge “Safety Yellow” and stencil system’s hoisting capacity in black painted characters, clearly visible from loading floor.

B. **Gears, bearing surfaces, and other machined surfaces** shall receive heavy application of rust-inhibiting coating that shall be maintained during storage and until equipment is Substantially Complete.

2.6 IDENTIFICATION

A. **Identify** component subassemblies with stainless steel nameplates and each labeled with the following:

1. Manufacturer and model number.

2. Date of the manufacture with pertinent ratings, operations, and maintenance information.

3. Certification, stamp, or approval, in accordance with laws and regulations.

PART 3 EXECUTION

3.1 INSPECTION

A. **Examine conditions** under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. **Before installing bridge cranes**, verify the following: that design strength of cast-in-place concrete supporting elements has been attained, structural steel or other support framing is properly erected, plumb, and level, in accordance with the Contract Documents, adequately bolted, braced and welded, and ready for installation of bridge crane system. Do not begin installing bridge crane equipment until building or structure is enclosed and weathertight.

C. **Inspect and verify** that no part of building, structure, piping, mechanical systems including ductwork, electrical systems including lighting and conduit, or other elements will interfere with proper operation of bridge crane system along entire length of runway and **entire** span of bridge. Verify that there is at least three inches clear between topmost part of bridge crane and lowest overhead construction.

3.2 INSTALLATION

A. Crane Rails:

1. General Contractor shall install the runway rails in accordance with the requirements established by the bridge crane installer. Set and adjust gage, alignment, and elevation of bridge crane rails to tolerances of CMAA 70 or CMAA 74, as applicable for the equipment provided. Stagger joint locations on opposite sides of runway. Rail joints shall be at least two feet from crane girder joints. Grind all surfaces smooth and provide flush joints at top of bridge crane rails.

2. Furnish and install hook bolts or weld rail clips to runway girders in the shop. Field welding is not allowed unless approved by the Engineer.

B. **Install materials and equipment** in conformance with Laws and Regulations, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents. Field welding of equipment shall be in accordance with

manufacturer's written instructions. Field welding to building or structure shall be in accordance with AWS D1.1.

C. **For requirements for the bridge crane supporting steel**, refer to Section 05 00 00, "Grating and Miscellaneous Metals" and Section 05 10 00, "Structural Steel".

3.3 FIELD QUALITY CONTROL

A. Site Tests:

1. After installing equipment and associated controls, perform at the Site running tests for bridge crane and appurtenances. Should testing indicate malfunction, make repairs and adjustments as required. Repeat testing adjusting until, in Engineer's opinion, installation is complete and equipment is functioning properly and accurately and is Substantially Complete. Equipment will not be Substantially Completion until field tests are successfully completed.

2. Load Test:

a. Perform load tests under supervision of manufacturer's factory-trained service technician, in presence of the Engineer.

b. Weights used in load testing shall be certified by a state or local bureau of weights and measures. Submit weight certification as part of load test report.

c. Load testing shall conform to ASME B30.2 or ASME B30.17, as applicable, and the following:

1. Power failure test with rated load: Load shall be held suspended when power is removed.

2. Bridge travel full length of runway with rated load, while verifying that all functions operate properly.

3. Trolley travel full length of bridge with rated load, while verifying that all functions operate properly.

4. Hoist brake drift test with rated load: Lift weight, measure distance to floor, allow five minutes to elapse, and re-measure. Record the results measured. Criteria for Acceptance: No difference in measurements.

5. Upper/lower limit switch test with no load.

6. Emergency stop test with no load.

d. Load Test Report: Submit results of load testing in a report that lists tests performed, data collected, results of each test, and corrective actions taken (if any). Test report shall be signed by manufacturer's service technician present during testing.

B. **Manufacturer's Services:** Provide services of qualified, factory-trained service technician to perform the following:

1. Instruct Contractor in installing equipment and assist with installing equipment.

2. Inspect and adjust equipment after installation, ensure proper operation, and supervise initial operations and load tests.

3. Instruct Owner’s personnel in operating and maintaining the equipment.

4. Manufacturer’s technician shall make a minimum of 3 visits to the site, with minimum number of hours on-site for each visit as specified.

    a. First visit shall be for instructing the Contractor in proper equipment installation and assisting in installing equipment. Minimum number of hours on-site: 8 hours.

    b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Minimum number of hours on-site: 8 hours.

    c. Third visit shall be to instruct operations and maintenance personnel. Number of hours on-site shall be in accordance with Section 01 79 00, Startup, Demonstration, and Training.

    d. Technician shall revisit the site as often as necessary until installation is acceptable.

5. Manufacturer’s Installation Certification: Submit certification that manufacturer’s technician has checked completed installation and equipment, as specified in the Contract Documents, has been provided in accordance with manufacturer’s recommendations, and that operation of equipment is satisfactory. Certification shall be signed by the manufacturer's technician present at the site and the Contractor.

6. Training: Furnish services of supplier’s qualified factory trained specialists to instruct the Owner’s operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction and qualifications shall be in accordance with Section 01 79 00, Startup, Demonstration, and Training.

7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

PART 4 EQUIPMENT SCHEDULE

4.1 GENERAL

A. **General**. Provide the under-running, close-headroom, cross mounted, wire hope, 2-part double reeved, motorized, single speed trolley, dual speed hoist that complies with requirements described in the specification that will travel on new runway rails attached to the existing runway beams to meet the proposed requirements.

Description	**Specifications**
Location	High Service Pump Room
Quantity	One (1)
CMAA Service Classification	C
Rated Hoisting Capacity	6-ton
Bridge Span (Between rail centerlines)	25.125-ft
Bottom of Roof Beams	994.50
Runway Rail - Top of 40# ASCE Rail	991.75
Clearance from Bottom of Ceiling Beam for Crane Girder, End Trucks, or Hoist	2.75-ft
Required Maximum Lift – Bottom of Hook to FF. El. 972.00	18-ft
Min. Hook Height from FF El 972.00 (Latch-type)	16.0-ft (new backwash pump)
Lifting Speed Minimum	5 fpm
Trolley Speed Maximum	30 fpm, VFD
Runway Length (Col. Line A to E)	80-ft
Trolley HP (Maximum)	5
Bridge Type	Single Girder, Top running
Maximum Bridge Horsepower	5
Power	460 V / 3 ph / 60 Hz
Control (Operate from FF Elev. 972.00)	Pendant Pushbutton
Hoist Maximum Horsepower	8
Electrification: Runway	
1. Runway	Festooning
2. Trolley and Hoist	Festooning
Maximum Hoist Side Approach. (Hook to centerline of runway beam.)	
1. North Side	2-ft
2. South Side	2-ft
Max Crane End Approach from Column Centerline	
1. West @ Column Line A	4.03-ft
2. East @ Column Line E	3.875-ft (new aluminum stair)

END OF SECTION

SECTION 41 22 23.16

PORTABLE DAVIT CRANES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.3 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install the portable davit-type crane and winch system in accordance with the drawings and as specified herein.

B. **Portable Davit Crane System**. The davit crane system shall be fabricated from high strength structural steel plate and/or shapes and designed for the intended load capacity requirements. The davit crane shall be free-standing and provided with top pivoting arm. The davit crane shall be portable and installed in pedestal base anchor assembly that is anchored to the concrete slab and designed to support the full design loads with a boom arm fully extended in the horizontal position. The davit arm shall extend out from the support column, and swivel in the base support. Each portable davit crane be fabricated in sections that can be easily assembled in the field. Sufficient base plate support assemblies shall be provided as shown on the contract drawing and list in the schedule. Each jib crane shall be provided with an equipment bag to store hoist, column, and davit arm. Each davit hoist system shall be provided with all necessary stops, guides, bolts, clips, plates, support connections, and incidentals for a complete system.

C. **Motorized Hoist and Trolley System**. The motorized hoist and trolley system shall be designed for up to 1 ton lifting capacity. The Hoist motor and controls shall be designed for operation in NEMA 4. All equipment shall be designed for outdoor service.

1.4 QUALITY ASSURANCE

A. **Codes**. Perform all work in compliance with all federal, state and local codes.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. MMA – Monorail Manufacturing Association.

2. HMI – Hoist Manufacturers Institute.

3. ANSI – American National Standards Institute.

a. ANSI B30.16, "Overhead Hoists."

4. NEC – National Electric Code

C. **Regulatory Agencies**. Perform all work in compliance with the requirements of the following regulatory agencies:

1. OSHA – Occupational Safety and Health Administration.

1.5 SUBMITTALS

A. **Product Data**. Manufacturer's product data in accordance with Section 01 33 00 shall be submitted to the Engineer for review.

B. **Shop Drawings**. Submit shop drawings for approval. Shop drawings shall be in accordance with Section 01 33 00 and shall include:

1. Manufacturer's name and model numbers.
2. Manufacturer's standard product data.
3. Equipment specifications.
4. Materials of construction.
5. Repair parts.
6. Dimensional layouts and required clearances.
7. Weights.
8. Anchor bolts.
9. Bill of material.
10. Complete description in sufficient detail to permit an item by item comparison with the specifications.
11. Manufacturer's instructions.
12. Warranty.

C. **Operation and Maintenance Manuals**. Submit operation and maintenance (O&M) manuals in accordance with Section 01 33 00. Submit the initial review copy of the O&M manual and six revised copies prior to delivery of the equipment.

D. **Personnel Qualifications**. Submit qualification statements, in accordance with Section 01 33 00, of all manufacturer's representative personnel that will be servicing the equipment with the six revised copies of the O&M manuals.

E. **Manufacturer's Representative Reports**. Submit manufacturer's representative reports within 48 hours of each site visit. Include product and material certifications, and inspection data as specified in Section 01 33 00, with this report(s).

F. **Test Report**. Submit test reports within 48 hours of completion, suspension, or termination of testing the monorail systems under all design conditions.

1.6 JOB CONDITIONS

A. **Coordination with Other Work**. Coordinate the scheduling of the work and the location of equipment with other trades to prevent delays, errors, and/or omissions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. **General**. Deliver, store, and handle the davit hoist systems in accordance with Section 01 60 00 and the manufacturer's instructions.

1.8 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. **Davit Assembly**. Mast and boom must rotate 360 degrees in sleeve bearing in base. Boom and ratchet style screw-jack are fastened to mast with quick-release pins for easy disassembly. Boom angle adjusts from 5 to 45 degrees with ratchet style screw-jack. Boom telescopes to four different positions with quick-release pin. Mast and boom are welded 304 electro polished stainless steel. Quick-release pins and fasteners are stainless steel. Mast height shall be minimum 48 inches above floor. Boom shall extend up to 84 inches from centerline of davit mast. Hook height with boom rotated up to 45-degree position and fully extended shall be 96 inches above floor.

B. **Power Operated Winch**. Electric motor is 115-volt single-phase, 60-cycle, totally enclosed, non-ventilated (TENV), with 8-foot power cord with grounded plug. Momentary contact-type pendant control switch on 6-foot cord. Worm gears are enclosed in oil bath. Cast aluminum gear case and drum with formed steel frame. Internal adjustable band-type load brake. Self-aligning bronze and ball bearings. Winch drum includes anchor slot for quick disconnect wire rope assembly. Power winch finish is gray alkyd enamel paint. Full drum capacity of 22 feet per minute.

C. **Wire Rope Assemblies**. 1/4-inch in diameter, 50 feet in length. Galvanized aircraft cable with swivel hook and swaged ball fitting.

D. **Davit Mast Bases**. Bases shall be pedestal mounted with welded 304 stainless steel construction, finished with corrosion-resistant electrostatic powder coating, and include anchor slot for quick disconnect wire rope assembly. Anchor bolts shall be sized by the davit crane manufacturer to meet the most severe duty and include minimum of 25% safety factor for the operating conditions listed in the schedule. Number of bases required is as listed in the schedule and will be field located by Owner/Engineer.

E. **Manufacturers**. Subject to compliance with the specifications, provide the davit assembly as manufactured from one of the following approved manufacturers and models with specified accessories or features.

1. Thern, Inc. USA, Winona, MN
2. Grainger Industrial Supply, Lake Forest, IL
3. Halliday Products, Orlando, FL
4. Approved equal.

2.2 FABRICATION

A. **Shop/Factory-Finishing**. Shop/factory-finishing shall be in accordance with Section 09 90 00, "Painting." For any non-stainless components. All mast bases shall be painted safety yellow.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**. Install the pump hoists specified herein as shown on the plans and in accordance with approved shop drawings and the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. **Manufacturer's Field Service**. The manufacturer shall provide a qualified representative to inspect the completed installation, service and operate the equipment under all design conditions with a Contractor-furnished test weight, instruct the Owner’s personnel in proper operating and maintenance procedures and provide Owner with a written certificate of approval in accordance with Section 01 33 00. Provide instruction of plant personnel as per Section 01 79 00.

3.3 EXAMINATION

A. **Site Verification of Conditions**. Verify that surfaces and site conditions are ready to receive work and the following conditions:

1. All materials delivered to the job site have been fabricated in accordance with the approved Shop Drawings and are free from obvious shipping damage or defects.

B. **Notification**. Notify the Engineer immediately of all unsatisfactory or nonconforming conditions.

C. **Responsibility**. Beginning the installation means the installer accepts the existing surfaces and conditions.

3.4 PREPARATION

A. **Protection**. Protect adjacent equipment, materials, piping, and valving against damage from hoist installation where required.

B. **Manufacturer's Instructions**. Complete preparatory work in accordance with manufacturer's instructions prior to equipment installation.

C. **Surface Preparation**. Comply with Section 09 90 00, "Painting."

PART 4 - EQUIPMENT SCHEDULE

4.1 GENERAL

A.	Location	Filter Pipe Gallery/ Filter Building No. 5 Access
	Quantity	1 (manual)
	Base Plate Assemblies	1 (pedestal)
	Capacity	850 lbs.
	Maximum boom extension (from center of mast to end of boom)	42-inches
	Maximum hook height Centerline of hook to pedestal base	72-inches See drawings
	Maximum Lift (Horizontal boom to bottom of hook)	17 feet

(Does not include allowance for grout or a steel leveling plate if required to distribute load of yoke assembly to concrete floor)

END OF SECTION

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SECTION 43 11 00

BLOWERS, GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, tools, equipment, and materials necessary to furnish and install the various blowers in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencie**s. Perform all work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards as referenced herein:

1. AFBMA - Antifriction Bearing Manufacturers' Association.
2. ANSI - American National Standards Institute.
3. ASME - American Society of Mechanical Engineers.
4. ASTM - American Society for Testing and Materials.
5. AWS - American Welding Society.
6. IEEE - Institute of Electrical and Electronics Engineers.
7. NEMA - National Electrical Manufacturers Association.

1.4 QUALITY ASSURANCE

A. Manufacturer of blower equipment specified shall have furnished blowers for not less than three (3) separate facilities in the United States each operating satisfactory for not less than one (1) year. Document not less than six rotary lube blowers (total) operating at their facilities that of similar flow capacity and motor horsepower equal to or greater than the equipment specified.

B. Manufacturer shall have an established base of operation in North America, that includes a service network, that employs experience, factory-trained technical personnel, resources, and services capable of completing checkout, startup, and troubleshooting of installed equipment specified.

1.5 SUBMITTALS

A. **General**. Submit the following in accordance with Sections 01 33 00 and 01 79 00.

1. Product data that includes:

2. Factory certified performance curves from previous tests of identical blower units indicating speed, capacity, horsepower, and efficiency over the range of operation.

3. Shop drawings.

4. Certified Performance Data. Test reports for all tests specified for:

   a. Motors.
   b. Blowers, including data and performance curve.
   c. Blower and motor unit.

5. Operation and maintenance (O&M) manuals.

6. Manufacturer's installation inspection report.

7. Others. As specified under various blower specifications.

1.6 **JOB CONDITIONS**

A. **Coordination**. Coordinate all work to prevent delays, errors, and/or omissions.

1.7 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**. All units shall be shipped assembled as much as practical. All units shall be labeled with all labeling intact and legible with item name, model number, size, and manufacturer's name.

B. **Storage**. All units, accessories, and components shall be stored in the manufacturer's original package, under cover and protected from damage. Maintain a grease coating on all bearings and shafts to prevent rusting. All filter material shall be kept dry and dust free. Blower shafts shall be turned at intervals as recommended by the blower manufacturer.

C. **Handling**. Handle all units and components in accordance with the manufacturer's instructions. Use lifting rings and canvas harnesses for lifting to prevent damage, scratching, or abrading finished surfaces.

1.8 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Blowers**

1. General. Blowers shall be heavy duty, suitable for continuous, efficient, and dependable service under operating conditions imposed by the installation and specific blower specification.

2. Castings. All castings shall be free of warp, fins, gas and pit holes, and other defects that might impair strength or appearance. Cast iron castings shall have a minimum tensile strength of 30,000 pounds per square inch (psi) and conform to the applicable ASTM standard.

3. Steel. All steel shall conform to the applicable ASTM standard. All welding shall be in accordance with the standards of the AWS.

4. Nameplate. An aluminum or stainless steel nameplate shall be attached to each blower in a clearly visible, easily accessible location. Nameplate shall be stamped with the following for each blower.

    a. Manufacturer's name.
    b. Model number.
    c. Serial number.
    d. Design capacity, standard cubic feet per minute (scfm).
    e. Design pressure, psi.
    f. Design speed, revolutions per minute (rpm).

B. **Blower Accessories**

1. Blower accessories shall be provided as indicated in the specific blower specification(s).

2. A temperature switch and pressure switches shall be provided by the blower manufacturer.

C. **Motors**

1. Motors shall be rated for continuous duty and normal starting torque unless otherwise specified or shown. Motors shall have NEMA Class F insulation. Drive motors shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, IEEE, ANSI, and AFBHMA standards as applicable.

2. Motor enclosure shall be as listed in the applicable equipment schedule. Motor enclosure notations are:

    a. E-P (EXP) - Explosion proof.
    b. TENV - Totally enclosed non-ventilated.
    c. TEFC - Totally enclosed, fan-cooled.
    d. ODP - Open drip proof.

3. Temperature rise shall not exceed IFC and NEMA standards for the class of insulation, service factor, and enclosure specified.

4. Motor performance shall conform to the requirements of NEMA MG1 Part 12 and shall be expressed as indicated in NEMA MG1-12.30 and a report of test for routine tests shall be submitted based on IEEE test procedure 112, Method B.

5. Motor terminals shall be provided and marked as required for the application described in NEMA MG1 Section 2 and as required in Division 26, "Electrical."

6. Motors shall have a 1.15 service factor rating. The blower brake horsepower (bhp) requirements shall not exceed the motor nameplate horsepower under the operating conditions as listed in the applicable Equipment Schedule.

7. Motors shall be designed to operate at the highest efficiency and power factor.

8. Motors shall be of standard manufacturer, General Electric, U.S. Motors, Reliance Electric, or equal.

9. Shop Test. Tests shall be performed in accordance with ANSI/IEEE Standard 112 and ANSI C52.1, parts 12 and 20 (NEMA MG1). When specified, the Engineer/Architect shall be notified and afforded the opportunity to witness the test.

    a. Routine Test. A certified report of a routine test of each motor furnished shall be submitted to the Engineer/Architect for acceptance. Tests shall include running light current, power input, and high potential.
    b. Certified Data. Unless otherwise specified, certified data shall be furnished for motor efficiency and power factor at 100 percent, 75 percent, and 50 percent of full load based on test data of a motor of identical design.
    c. Full Test. When specified, a certified report of a full motor test of each motor furnished shall be submitted to the Engineer/Architect for acceptance. Tests shall include full load heat run, percent slip, running light current, locked rotor current, starting torque, efficiencies and power factor at 100 percent, 75 percent, 50 percent full load, and winding resistance and high potential tests.

10. Motor Nameplate. An aluminum or stainless steel nameplate shall be attached to each motor clearly visible showing operational data in accordance with NEMA MG-1.

11. Inverter Duty.

    a. All motors indicated by the equipment schedule to be powered from variable-frequency alternating-current drives (VFD) shall have the following features in addition to those listed above:

        1) Designed for use on pulse width modulated (PWM) VFD without external filters or cable length limitations.
        2) Inverter grade, 1,600 volt, Class F insulation.
        3) Service factor of 1.0 when operated from a VFD.
        4) Normally closed thermostat on stator windings.
        5) Meeting requirements of NEMA MG1 Part 31

2.2 **FINISHES**

A. **Exterior Surfaces**. All surfaces exposed shall be shop primed and field finished in accordance with Section 09 90 00, "Painting," under "Interior Nonsubmerged Ferrous Metals and Equipment." All surfaces not exposed after installation shall be shop finished or shop primed and field finished prior to installation.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. **Site Verification of Conditions**. Prior to installation of equipment, verify that:

1. All clearances have been met.
2. Bases, anchors, supports, and openings are located correctly and are of the proper size and material.

B. **Variations**. Any variations of the requirements shown on the drawings or required by the manufacturer shall be corrected at no additional cost to the Owner. All methods of correction shall be submitted in writing and acceptable to the Owner and/or Engineer/Architect.

3.2 **PREPARATION**

A. **Protection**. All surface areas shall be protected from damage. All finished floors shall be protected with a waterproof, oil resistant cover to prevent staining from oil and/or grease.

3.3 **INSTALLATION**

A. **General**. All blowers and components shall be installed in accordance with the manufacturer's instruction and the conforming shop drawings, including all gasket seals, isolation dampeners, cleanouts, drains, gauges, motors, controls, and power wiring.

B. **Manufacturer's Field Service**. A qualified representative of each equipment manufacturer shall inspect the completed installation, service the equipment, operate the equipment under all design conditions, instruct the Owner's personnel in proper operating and maintenance procedures, and provide the Owner with a written certificate of approval.

C. **Set anchor bolts** in accordance with the approved manufacturer's conforming submittals.

D. **Lubrication.** Contractor shall furnish and apply an initial supply of grease and oil as recommended by the manufacturer and shall grease and oil the equipment throughout all testing until completion.

E. **Interface with Other Products**

1. Complete all electrical power and control connections.
2. Install and connect all piping, valves, and gauges.

F. **Inspection**

1. The Contractor shall inspect all parts of the blower for proper installation and conformance to the drawings and manufacturer's recommendations.

3.4 REPAIRS/RESTORATION

A. **Damages**. Any chips, dents, scratches, stains, or other disfiguring of surrounding floors, walls, and/or accessories shall be repaired or replaced to the satisfaction of the Owner and/or Engineer/Architect at no additional cost to the Owner.

3.5 CLEANING

A. **Surface**. The blower, motor, accessories, and surrounding areas shall be cleaned of all foreign material, grease, and oil stains.

B. **Airway**. Remove all rags, sticks, debris, and construction materials. Damage to equipment components shall be replaced in like kind at no additional cost to the Owner.

C. **Protection**. After cleaning, provide protective covering for each piece of equipment from damage.

3.6 FIELD QUALITY CONTROL

A. **Field Testing and Inspections**

1. **General.** Contractor and qualified factory trained field service repetitive employed by blower manufacturer shall perform tests and inspection to remedy defects as necessary and as specified herein.
2. **Operating Tests:**
    a. Field test each blower together with its controls and appurtenances. Test shall verify that each part and all parts function at the design point specified.
    b. Vibration test each blower to ensure excessive vibration does not exceed manufacturer’s tolerance.
    c. Measure the noise and temperature rise across the entire operating range and ensure they do not exceed what is specified and the manufacturer’s tolerance.
    d. Inspect equipment during and after testing for defects. If the equipment does not comply with the Contract Documents and does no pass the tests, that Contractor shall adjust, modify, and retest the equipment until all tests are successfully passed at not additional cost to the Owner.
    e. Verify all controls operate as intended in all operating modes.

B. **Manufacturer's Field Service**

1. Blower manufacturer shall provide a written and signed statement that the blowers have been installed properly in accordance to the Contract Documents, manufacturer’s recommendations, and is ready for operation by the Owner.

2. Perform field inspection of all components prior to placing in operation and submit manufacturer's installation inspection report addressing the following:

    a. List of deficiencies found.
    b. Recommended corrective action for all deficiencies.
    c. Certification by manufacturer's representative that items are properly installed, aligned, and adjusted.

3.

3.7 DEMONSTRATION

A. **Visual**. The Contractor, Owner, and/or Engineer/Architect shall inspect the equipment for visual deficiencies.

B. **Tests**. Dry and wet tests shall be performed and the equipment adjusted as specified in Section 01 79 00, "Start-up, Demonstration, and Training."

C. **Noise Tests.** The Contractor, in the presence of the manufacturer's representative and the Engineer/Architect, shall measure the sound level. The Contractor shall show that the decibel meter used is calibrated. Sound level shall be measured for one unit operating at a time and measured 3 feet from the unit in all directions. The Contractor shall submit a field test report as specified in Section 01 79 00.

D. **Operational Demonstration**. An operational demonstration shall be performed as specified in Section 01 79 00, "Start-up, Demonstration, and Training." Verify and note in the operational demonstration log that all design conditions for blower capacities and pressures, and motor nameplate data have been equaled or exceeded for the demonstration period.

3.8 EXTRA MATERIAL

A. **Spare Parts**. The spare parts called for in the various blower specifications shall be protected and packaged as recommended by the manufacturer. Each package shall be tagged for positive identification noting:

1. Part name.
2. Part number.
3. Associated equipment name and number.
4. Manufacturer's name and address.

END OF SECTION

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SECTION 43 11 33

BLOWERS, POSITIVE DISPLACEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 43 11 00, "Blowers, General"; and all other related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide all labor, tools, equipment, and materials necessary to furnish and install the positive displacement blowers in accordance with the plans and as specified.

1.3 QUALITY ASSURANCE

A. **General**. In accordance with Section 43 11 00, “Blowers, General.”

B. **Source**. All positive displacement blowers shall be of the same manufacturer. All drives shall be of one manufacturer.

1.4 SUBMITTALS

A. **Product Data**. Furnish manufacturer's product data including blower curves, accessories, options, dimensions, weights, and list of special tools in accordance with Section 01 33 00 to the Engineer/Architect for review. In addition, provide the following:

1. Catalog information showing the details of blower, motor, belt drives, valves, and other appurtenances.
2. Silencers and flexible connection data.
3. Control panel and associated components.
4. Blower system instrumentation provided by the manufacturer that includes vibration monitoring and control, ammeter, switches, pressure and temperature sensors and transmitters, temperature protection devices, and limit switches.

B. **Performance Data**. After award of the Contract, the Contractor shall submit performance data and curves for preliminary review of the blower equipment to be furnished. Such data shall be based on actual tests of similar equipment and include sufficient data to demonstrate suitability of both the blower and driver for the conditions specified. Data shall include certified performance curves from previous tests of identical blower units indicating speed, capacity, horsepower, and efficiency over the range of operation.

C. **Shop Drawings**. Shop drawings shall be submitted to the Engineer/Architect in accordance with Section 01 33 00 showing materials, accessories, coatings, dimensional layouts, anchor bolts, sectional views of blower construction, driver specifications, wiring diagrams, and a bill of materials.

1. Equipment fabrication drawings shall include materials, weights, and dimensions on a plan with section views of the blowers.
2. Control panel layout drawings with process and instrumentation.

D. **Quality Control.** Source quality control results shall include written results of both the blower and motor equipment standard factory tests and inspections. Field quality control results shall include written results of the field performance testing, vibration testing, and sound test. The blower manufacturer shall provide a written and signed statement that the blowers have been installed properly in accordance to the Contract Documents, manufacturer's recommendations, and is ready for operation by the Owner.

E. **Operation and Maintenance Manuals**. Submit operation and maintenance manuals (O&M) in accordance with Sections 01 33 00 and 01 79 00. The initial review copy of the O&M manual and six revised copies shall be submitted to the Engineer/Architect prior to delivery of the equipment.

F. **Personnel Qualifications**. Qualification statements, in accordance with Section 01 33 00, of all manufacturer's representative personnel that will be servicing the equipment shall be submitted with the six revised copies of the O&M manuals.

G. **Manufacturer's Representative Reports**. Manufacturer's representative reports, in accordance with Section 01 79 00, shall be submitted within 48 hours of each site visit. Product and material certifications and inspection data as specified in Section 01 33 00 shall be included with this report(s).

H. **Test Report**. A test report, in accordance with Section 01 79 00, shall be submitted within 48 hours of completion, suspension, or termination of testing the blowers under all design conditions.

I. **Noise Performance and Tests**. Each blower with a silencer shall be factory tested and shall produce a sound pressure level as specified in the Equipment Schedule. Exact test procedure proposed shall be submitted to the Engineer/Architect prior to testing. Test results shall be certified and submitted to the Engineer/Architect and the Engineer/Architect shall be given opportunity to witness the tests. Any blower system not passing this test will not be accepted and shall not be shipped. Individual blower system noise production data at maximum pressure and various speeds shall be submitted with the shop drawings. Such data shall be based on actual tests of similar equipment.

1.5 **JOB CONDITIONS**

A. **General**. See section 43 11 00, "Blowers, General."

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. See section 43 11 00, "Blowers, General."

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **BLOWER**

A. **Type**. Blowers shall be rotary, positive displacement, tri-lobe type, operating without internal sealing fluid or rubbing parts. The blower systems shall be packaged mounted, factory engineered, pre-assembled units.

B. **General.** Blowers shall be in accordance with section 43 11 00, "Blowers, General."

C. **Package System Frame**. The framing system shall be ruggedly built, capable of supporting the operating machine without visually discernible vibration. The base plate shall be a minimum of 3/8-inch-thick steel. Two full-side mounting plates shall be provided. All welds shall meet the requirements of the American Welding Society (AWS) and shall be continuous.

D. **Casings**. The blower casings shall be of cast iron, (one-piece construction for accurate operating clearances). The case shall be suitably ribbed to prevent distortion under the operating conditions. End or head covers shall be removable for easy access for bearing and gear inspection. The inlet and discharge connections shall be internal national pipe thread (NPT) threads or flanges drilled and tapped to Class 125 American National Standards Institute (ANSI) B16.1 specifications. Oil baths shall be fitted with fill, drain, vent, and level gauge appurtenances. Provide pipe extensions on fill and drain connections for easy access.

E. **Impellers**. The impellers shall be cast or ductile iron integral with or permanently fastened to the shaft that are of one piece. Impellers shall be straight or hybrid, tri-lobe type designed to operate without contact. The rotors shall be machined, ground, and dynamically balanced to prevent excessive vibration. The first critical speed shall be greater than 1.2 times maximum rotating speed.

F. **Timing Gears**. The timing gears shall be manufactured of heat-treated alloy steel. The timing gears shall be splash oil lubricated from internal oil reservoirs with precise rotor synchronization to maintain satisfactory operating clearances. The timing shall be field adjustable. Gears shall be secured with tapered shaft ends.

G. **Seals**. Seals shall be located at each bearing. The seals shall be replaceable without disturbing the blower mounting or piping. Seal design shall prevent lubricant from contaminating the air stream. Seal design shall be a double sealing arrangement and include a piston ring type labyrinth inner seal.

H. **Bearings**. The bearings shall be antifriction type and designed for a minimum Anti-friction Bearings Manufacturers Association (AFBMA) B-10 bearing life of 100,000 hours. A cylindrical roller bearing shall be provided at the drive shaft designed to handle all radial and thrust loads while either a single-row ball bearings or cylindrical roller bearing shall be used at other locations. Both the drive-end and gear-end bearings shall be oil splash lubricated with oil seal to prevent leakage into the air stream. Grease lubricated bearings are not acceptable.

I. **Shafts.** Shafts shall be constructed of forged alloy steel or high-strength ASTM A395-60-45-15 ductile iron.

J. **Base**. The blower and drive shall be mounted on a common fabricated steel base with an adjustable drive base and anchor bolts. The base shall be mounted on a level concrete pad. Blower equipment shall be properly aligned with respect to the piping, the drive, and the base to minimize transmission of stresses and vibration.

K. **Accessories**

1. V-Belts and Guards. Blowers and drives shall be connected with multiple V-belts and sheave arrangement, complete with Occupational Safety and Health Administration (OSHA) type guard. Additional sheaves shall be supplied for each blower for a speed of 80 percent of the design capacity speed. The belt shall be rated for 175% of the motor horsepower. The guard shall be of sturdy welded steel construction without sharp edges or projections. Guards for outdoor service shall provide weather protection for the belt drive.

2. Check Valves. Check valves shall be provided for the discharge piping on each blower between the pressure relief valve and discharge silencer. The valves shall match the size of the discharge piping shown on the drawings. The valves shall have a cast iron body, flanged, with bronze and stainless-steel trim and shall be suitable for 25 pounds per square inch (psi) working pressure and 275 degrees Fahrenheit (^{o} F.) continuous operating temperature; internal spring is not allowed.

3. Butterfly Valves. Butterfly valves shall be provided for the discharge piping on each blower. The valves shall match the size of the piping shown on the drawings. The valves shall have a cast iron body, flanged, with bronze and stainless-steel trim and shall be suitable for 25 psi working pressure and 275^{o} F. continuous operating temperature. The stem shall be bushed and sealed. Valve sizes through 8 inches shall be equipped with a lever operator and locking device. Valves over 8 inches shall be equipped with an enclosed traveling nut operator, handwheel, and indicator.

4. Relief Valve. Each blower unit shall be supplied with a weighted-type relief valve for installation in the discharge line. The relief valve shall have sufficient capacity to prevent overloading the blower and motor when operating at design capacity with the discharge valve in the blower discharge line closed. The valve shall include sufficient weights for a setting of 0.5 to 1 psi above the design differential pressure and set as recommended by the blower manufacturer.

5. Unloading Valve. An unloaded start valve, if required by the blower manufacturer, shall be provided and factory installed to allow the motor to accelerate prior to system pressurization and eliminate pneumatic shock. If not provided, manufacturer shall provide reasoning on why it is not required and how pneumatic shock will be eliminated.

6. Silencers. Each blower shall be equipped with an intake and a discharge silencer to attenuate pulsation noise. Silencers shall be of the absorptive type and be either cast iron or pressure vessel steel. The silencers can be directly mounted to the inlet and outlet part of the blower or be isolated from the blower ports by flex joints to mitigate vibration transmission and stress on the blower parts due to thermal expansion. The silencers shall be sized to handle between 105 to 120 percent of the design capacity specified in the Equipment Schedule and minimize pressure loss.

7. Flexible Connectors. Flexible connectors shall be provided for the inlet and discharge piping on each blower. The connectors shall be wire reinforced synthetic rubber compatible with the size and type of piping shown. The connectors shall be suitable for 25 psi working pressure and 275º F. operating temperature. The connectors shall be tied with resilient mounted steel rods or otherwise restrained from over extension due to internal pressures. Provide sufficient distance between the blower package and connecting discharge process air piping for sufficient expansion without touching.

8. Sound Enclosure. A sound enclosure shall be provided, unless noted otherwise. The sound enclosure shall be sheet steel construction with powder coat finish. It shall provide sound attenuation of up to 22 dB(A). The enclosure shall have hinged or removable panels for easy access and maintenance. A vent system sized to provide adequate cooling of the package shall be provided. The enclosure shall include a “through the enclosure” air intake option to allow for direct connection to intake air piping. The enclosure shall include, but not limited to, the blower, motor, v-belt drive, silencers, cooling fan, and interconnecting piping between blower and silencers.

9. Enclosure Cooling and Ventilation. Shall be either mechanical or electrical driven cooling fan, properly sized for cooling and ventilating the sound enclosure.

10. Temperature Gauge. A temperature gauge, with adjustable switching point and contact, shall be provided pre-piped and panel mounted on the sound enclosure. The contact closure shall shut the motor off in the event of an unsafe blower temperature is reached.

11. Pressure Gauge. A pressure gauge shall be provided, pre-piped and panel mounted in the sound enclosure.

12. Intake Filter. Unless otherwise shown, each blower shall be provided with a flanged dry type inlet filter sized for 120 percent of the design capacity. The sizing and design of the filter shall be suitable for fully exposed outdoor service. Filter element shall be cleanable and replaceable. The filter shall be equipped with a filter restriction indicator suitable for up to 20 inches of water vacuum. The filter restriction indicator shall be provided pre-piped and panel mounted on the sound

enclosure. Filter particle size shall be per the blower manufacturer's recommendations.

13. Vibration Suppression. Vibration isolators or mounts shall be provided. Blower manufacture must insure proper selection for the specific blower system offered.

14. High-Temperature Shutdown Switch. Equip each blower with a single set point, factory installed high temperature safety switch in a National Electrical Manufacturers Association (NEMA) 4 enclosure with contact closure output to shut the motor off in the event an unsafe blower temperature is reached. The switch shall operate on the vapor pressure principle and shall be Ashcroft P-series, or equal.

15. Thermal Switches. Include three normally closed thermal switches (one per phase) embedded in the stator windings in the pump motor. Thermal switches shall be wired to terminals located in the motor terminal box. Provide motor terminal box of adequate size to allow installation of motor terminal kits without interfering with terminals on damaging control wiring.

16. Pressure Switch. The equipment manufacturer shall furnish with the process equipment, a high pressure protector. The control shall utilize a pressure sensor/isolator to separate the process air from the pressure sensing instrumentation. The process air pressure shall be transmitted by liquid silicone oil sealed between carbon steel housing and a flexible elastomer element. The pressure shall be monitored by a non-indicating pressure switch in a NEMA-4 enclosure, except in Class I, Division 2 areas where it shall be NEMA 7/9. The pressure switch shall stop the pump if high discharge pressure occurs.

    The pressure sensor elastomer element shall have integrally molded flange face gaskets and lip seals.

    The pressure sensor shall be compatible with 150 lb. (300 lb.) ANSI flanges. Switch shall be interlocked to blower control to shut the blower down in the event the blower discharge pressure exceeds predetermined set point(s). Conduit, wire, and installation of same shall be by Division 26. See Electrical Control Diagrams for switch operation and additional information.

L. **Manufacturer**. Positive displacement blowers shall be as manufactured by:

1. Universal Blower Pac (Base Bid)
2. Aerzen USA
3. Dresser Roots Blowers
4. Excelsior Blower Systems
5. Gardner Denver

2.2 **DRIVES**

A. **Type.** Motor shall be squirrel cage induction type and of the size and configuration listed in the Equipment Schedule and as specified in Section 43 11 00.

B. **Connections.** Motor shall be belt drive with lead connections necessary to properly function with the type of full voltage or reduced voltage starters indicated on the one-line power diagram of the electrical plans.

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. **In accordance with Section 43 11 00**, "Blowers, General."

3.2 **FIELD QUALITY CONTROL**

A. **In accordance with Section 43 11 00**, "Blowers, General."

3.3 **DEMONSTRATION**

A. **In accordance with Section 43 11 00**, "Blowers, General."

3.4 **EXTRA MATERIALS**

A. **Spare Parts.** In accordance with Section 43 11 00, "Blowers, General."

1. Seals. Provide one spare set of seals for each blower.
2. Bearings. Provide one spare set of bearings for each blower.
3. Belts. Provide one spare set of belts for each blower.
4. Sheaves. Provide extra sheaves for 80 percent of the design capacity speed for each blower.
5. Filters. Provide one spare set of filters for each blower.

PART 4 - SCHEDULE

4.1 **GENERAL REQUIREMENTS**

A. **Compressed Fluid** Air

B. **Inlet Conditions of Air**

1.	Temperature	100° F.
2.	Atmospheric Pressure	14.2 psi
3.	Relative Humidity	36%
4.	Elevation	970' MSL

C. **Standard Conditions of Air**

1.	Temperature	68° F.
2.	Atmospheric Pressure	14.7 psi

3.	Relative Humidity	36%
4.	Specific Weight	0.075 pcf

4.2 **DESIGN REQUIREMENTS**

A. **Design Speed and Pressure.** The design speed and pressure shall not exceed 85 percent of the published maximum design speed or pressure of the blower.

4.3 **AIR SCOUR BLOWERS**

A. **Number of Blowers** 2 (variable speed)

B. **Operating Conditions**

1.	Design Capacity	150 – 770 scfm
2.	Design Differential Pressure	6.40 psi
3.	Maximum blower input speed	4,000 rpm
4.	Static Back Pressure	3.11 psi
5.	Intake Losses.	
	a. Filter	0.23 psi
	b. Silencer	0.06 psi
	c. Piping	0.02 psi
6.	Discharge Losses.	
	a. Silencer	0.05 psi
	b. Piping	0.18 psi
	c. Diffuser	2.30 psi

7. Maximum Noise Level at three (3) feet w/sound enclosure: 80 Db(A)

C. **Motor Requirements**

1.	RPM.	1,800 or 3,600
2.	Horsepower.	40 hp (maximum)
3.	Voltage.	460 volts
4.	Phase.	3 phase
5.	Hertz.	60 Hz
6.	Enclosure.	TEFC

END OF SECTION

SECTION 43 21 00

PUMPS, GENERAL

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the various pumps in accordance with the plans and the specifications.

1.3 **QUALITY ASSURANCE**. Materials and workmanship shall be in accordance with the following standards as referenced herein.

A. **ANSI**. American National Standards Institute.

B. **ASTM**. American Society for Testing and Materials.

C. **AWS**. American Welding Society.

D. **HI**. Hydraulic Institute.

E. **IEEE**. Institute of Electrical and Electronics Engineers.

F. **NEMA**. National Electrical Manufacturers Association.

G. **AFBMA**. Anti-Friction Bearing Manufacturers Association.

H. **API**. American Petroleum Institute.

1.4 **SUBMITTALS**

A. **General**

1. Submit all required documents and materials in accordance with Section 01 33 00, this section, and the individual pump specifications.
2. All submittals shall be submitted only under individual pump section designations and not Section 43 21 00, "Pumps, General."

B. **The following submittal content and schedule requirements** are required to be submitted when indicated by the individual pump specifications.

1. **Shop Drawings and Product Data.**

a. Schedule that includes dimensional data and a bill of materials, which shall be keyed to numbers to all components of the pump assembly identifying them by name and part or catalog number. No other submittal packages related to this equipment can be approved before this one.

b. Cross section of the pump assembly with individual components identified and details of shaft couplings that includes maximum allowable angular and parallel misalignment.

c. Include dimensional data and a bill of materials, which shall be keyed to numbers to all components of the pump assembly identifying them by name and part or catalog number.

d. Submittal Package Contents.

1) Product data.
2) Shop drawings.
3) Performance Data.
   a) Based on actual tests of similar equipment and include sufficient data to demonstrate suitability of both the pump and driver for the conditions specified.
   b) The data shall include the type and make of pump, size, capacity, motor horsepower, motor speed, and performance curve.

2. **Source Quality Control Documents.**

a. Schedule. No equipment can leave the factory until this submittal package has been approved.

b. Submittal Package Contents.

1) Pump shop test report.
2) Motor shop test report.

c. Verification that the impeller has been balanced within the tolerances of a dual plane dynamic balance in accordance to ANSI/HI 14.4 and ISO 1940 Grade 2.5.
   1) Provide documentation detailing the impellers were fabricated per design specified herein.

d. Bearing Calculations, supports, lubrication provisions, test results, torsional calculations, pump shaft deflection, and fatigue analysis. The manufacturer shall provide a certified statement the the ABMA B-10 bearing life is meet or exceed the specified requirements.
   1) Maximum allowable temperature, natural frequency, and bearing life calculations.

e. Provide certification that confirms the pumps have successfully passed testes specified. Certificates shall be certified by the manufacturer and shall be notarized, and be provided with product data.

3. **Start-Up Preparation Documents.**

a. Schedule. This submittal package must be approved before the equipment start-up may take place.

b. Submittal Package Contents.

1) Initial operation and maintenance (O&M) manual.
2) Start-up request. Field testing procedures and forms with proposed instrumentation for approval at least 30 days before the scheduled test date and include a 14-day test plan and schedule on activities necessary for the process commission testing.
3) Training schedule.
4) Instructor qualifications.
5) Instructional materials.

4. **Operational Demonstration Preparation Documents.**

a. Schedule. The operational demonstration can not begin until these documents are approved.

b. Submittal Package Contents.

1) Manufacturer's representative reports from equipment start-up.
   a) Provide results from the vibration tests performed conforming the pump is in accordance with ANSI/HI 9.6.4.
   b) Report shall include procedures, interpretation of the results and recommendations found from the analysis.
   c) Letter from an Authorized Officer who is employed by the Pump Manufacturer directly, and not by employees of the sales representative, verifying that the layout of the pumps have been reviewed and meets the requirements of the contract documents.
2) Pump performance curves of the pumps specified after all equipment specified is installed with the operating points specified herein that shows:
   a) Total Dynamic Head (TDH) versus capacity in gallons per minute (GPM).
   b) Net Positive Suction Head Required (NPSHr) versus Capacity in GPM.
   c) Pump Efficiency vs. Capacity in GPM.
   d) Pump Brake Horsepower vs. Capacity in GPM.
3) Revised O&M manuals.
4) Operational demonstration request.
5) Sample operational demonstration log.

5. Operational Demonstration Documents.

a. Schedule. The operational demonstration must be completed before these documents can be submitted.

b. Submittal Package Contents. Completed operational demonstration log.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**

1. Ship all units assembled as much as practical.
2. Label all units with all labeling intact and legible with item name, model number, size, and manufacturer's name.

B. **Storage**

1. Store all units, accessories, and components in the manufacturer's original package, under cover and protected from damage.
2. Maintain a grease coating on all bearings and shafts to prevent corrosion.
3. Turn pump shafts at intervals recommended by the pump manufacturer.

C. **Handling**

1. Handle all units and components in accordance with the manufacturer's instructions.
2. Use lifting rings and canvas harnesses for lifting to prevent scratching or abrading finished surfaces.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **PUMPS**

A. **Manufacturer**

1. In accordance with the individual pump specifications.
2. All pumps of a given type shall be of the same manufacturer.

B. **Description**. Pumps shall be heavy duty, suitable for continuous, efficient, and dependable service under operating conditions imposed by the installation and specific pump specification.

C. **Performance**

1. See the individual Equipment Schedules in each pump specification section for capacity, head, speed, minimum solid size, and other pertinent data for each type of pump.

2. NPSHR/NPSHA ratio shall be the minimum recommended by ANSI/HI.

3. The specific parameters of the three conditions defined below are included in the Equipment Schedule when applicable.

a. Condition One – Full Speed Operation, Design Flow Rate at Maximum Head. This condition listed in the equipment schedule must be met by the supplied pump operating within its allowable operating region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3.
b. Condition Two – Full Speed Operation, Minimum Anticipated Head. This condition must be met by the supplied pump operating within its preferred operating region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3. Proposed pump selections meeting this head-capacity requirement by operating the equipment at less than full speed will be rejected.
c. Condition Three – Reduced Speed Continuous Operation. This condition must be met by the pump operating within its preferred operating region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3. Proposed pump selections must be able to meet this condition operating 24 hours per day.

4. The pump shall be able to pass a solid object up to the minimum diameter listed in the Equipment Schedule completely through the pump.

D. **Materials**

1. Cast iron castings shall have a minimum tensile strength of 30,000 pounds per square inch (psi) and conform to the applicable ASTM standard.
2. All steel shall conform to the applicable ASTM standard.

E. **Fabrication and Assembly**

1. Pumps shall be factory-assembled units unless noted otherwise.

2. All castings shall be free of warp, fins, gas and pit holes, and other defects that might impair strength or appearance.

3. All welding shall be in accordance with the standards of the AWS and ASME Standards.

4. Nameplate. Attach an aluminum or stainless steel nameplate to each pump in a clearly visible, easily accessible location. Stamp each nameplate with the following for each pump.

a. Manufacturer's name.
b. Model number.
c. Serial number.
d. Design capacity, gallons per minute (gpm).
e. Design head, feet.
f. Design speed, revolutions per minute (rpm).

5. Casings. Suction and discharge openings shall be flanged in accordance with ANSI B16.1 Class 125 unless noted otherwise.

6. Impellers.

    a. Accurately machined and dynamically balanced.
    b. Secure impellers to the shaft with a key-and-nut arrangement to permit easy removal and to prevent backing off unless noted otherwise.

7. Bearings.

    a. Properly lubricated, antifriction type, and capable of withstanding all radial and thrust loads.
    b. Bearing housings shall be rigidly supported, and exclude dirt and foreign matter from the bearings.
    c. Designed for a minimum L10 life of 100,000 hours at the operating point in accordance with AFBMA.

8. Stuffing Boxes. Stuffing boxes shall be deep, accessible, and sized for mechanical seals.

9. Pump Bases.

    a. Mount pump and motor on a common cast iron or fabricated steel base unless noted otherwise.
    b. Sufficiently reinforce and brace the base to withstand all shock loads and resist all wearing and buckling during pump operation.
    c. Collect leakage at one point for connection to a floor drain.

10. Belt-Driven Pumps. When the furnished pump is being driven by belts instead of directly linking the motor and pump by a hard coupling, the following requirements also apply.

    a. Belt Guards.

        1) Enclose pump drive transmissions on all sides by a sheet metal guard except that maximum perforated or expanded openings shall not exceed 1/2 inch.
        2) Manufacture guards to permit complete removal from the pump unit without interference from any other unit component.
        3) Securely fasten and brace guards to the unit base.
        4) All metal shall be free from burrs and sharp edges.
        5) Structural joints shall be continuously welded.
        6) Panels may be riveted to frames with not more than 5-inch spacing.

    b. Belts. Belts shall be the banded type.

2.2 MOTORS

A. **Manufacturer**. Subject to compliance with the specifications, the pump motors shall be supplied by one of the following manufacturers:

1. U.S. Motors.
2. Reliance Electric/Baldor.
3. Or approved equal.

B. **Performance**

1. Rated for variable speed or continuous duty as indicated in the Equipment Schedule and normal starting torque unless otherwise specified or shown.

2. Temperature rise shall be in accordance with NEMA limits for the class of insulation, service factor, and enclosure specified.

3. Rated for a frequency of 60 hertz (Hz).

4. Performance shall conform to the requirements of NEMA MG1 Part 12 and shall be expressed as indicated in NEMA MG1-12.31, and a report for routine tests shall be submitted based on IEEE Test Procedure 112, Method B.

5. Minimum 1.15 service factor rating unless noted otherwise.

6. The pump brake horsepower (bhp) requirements shall not exceed the motor nameplate horsepower (hp) under the operating conditions as listed in the applicable Equipment Schedule.

7. NEMA Premium Efficiency type except for submersible motors.

8. Inverter Duty. All motors indicated by the equipment schedule for variable-speed duty shall have the following features in addition to those listed above.

    a. Designed for use on pulse width modulated variable-frequency drives (VFDs) without external filters or cable length limitations.
    b. Inverter-grade, 1,600-volt, Class F insulation.
    c. Service factor of 1.0 when operated from a VFD.
    d. Normally closed thermostat on stator windings.
    e. Meeting requirements of NEMA MG1 Part 31.

C. **Assembly and Fabrication**

1. Minimum NEMA Class F insulation.

2. Motor enclosures shall be as listed in the applicable equipment schedule. Motor enclosure notations are:

    a. TENV – Totally enclosed nonventilated.

b. TEFC – Totally enclosed fan-cooled.
c. ODP – Open dripproof.
d. WP-1 – Weather-protected No. 1.
e. WP-2 – Weather-protected No. 2.

3. Provide and mark motor terminals as required for the application described in NEMA MG1 Section 2 and required in Division 26, "Electrical."

4. Space Heater.

a. For all motors not provided with epoxy-coated windings, provide a space heater for the purpose of reducing condensation during nonoperating periods.
b. Heaters shall be cartridge type or flexible wraparound type installed adjacent to the core iron.
c. Heaters shall be rated 120 volts, single phase.
d. Separately wire the space heater terminals to a terminal block or pigtails in the power conduit box.
e. Note the space heater rating in watts and volts on the motor nameplates.

5. Motor Nameplate. Attach an aluminum or stainless steel nameplate to each motor clearly visible showing operational data in accordance with NEMA MG1.

D. **VFDs**. Where specified in the Equipment Schedule, provide VFD as specified in Section 26 29 00, "Motor Controllers," and as shown.

2.3 ACCESSORY PRODUCTS (When specified in individual pump specifications)

A. **Anchor Rods**. Anchor rods, washers, and nuts shall be Type 316 stainless steel and shall be of ample size and strength for the intended purpose. Size and number shall be as recommended by the manufacturer.

B. **Coupling**. Connect pump and drive with a flexible coupling complete with Occupational Safety and Health Administration (OSHA) type guard. Coupling should be spacer type for horizontal pumps.

C. **Drain Piping**. Type L copper drain piping (size recommended by the pump manufacturer).

D. **Pressure Gauges**

1. Pressure gauges shall be Bourdon type, Type 316 stainless steel case, plastic window, 4-1/2-inch dial and liquid-filled.
2. Discharge pressure gauges shall be capable of reading from 0 to twice the specified pressure in psi with a ±1 percent accuracy.
3. Suction pressure gauges shall be the compound type capable of reading from 0 to 30 psi and also vacuum pressure from 30 to 0 inches of mercury with ±1 percent accuracy.

4. Furnish and install gauges with a pulsation dampener, a brass ball isolation valve, and brass connections as required for vertical mounting.
5. Gauges shall be Ashcroft, Marsh, Wika, or equal.

E. **RTD Motor Bearing Temperature Sensors**

1. Pump motor to include 100-ohm platinum resistance temperature detector (RTD) on upper thrust bearing and lower alignment bearing of motor for monitoring of temperature.
2. Coordinate RTDs with instrument supplier.
3. Mount RTDs at the factory before shipment to the job site.

F. **Suction Hand Hole Reducer**. Pump shall come complete with a suction-mounted, flanged cast iron eccentric reducer with a large hand hole.

G. **Vibration Sensors**. Furnish a combination vibration sensor/signal conditioner, including a conduit elbow and reducer, on the pump bearing frame. Metrix or equal.

H. **Thermal Motor Protection**. Include temperature switches for motors below 100 hp or stator windings and bearing reservoir RTDs for motors 100 hp and above.

1. Temperature Switches.

   a. Equip the motor with three embedded temperature switches in the stator.
   b. Temperature switches shall be normally closed (NC) configuration.
   c. Connect temperature switch wiring to terminals in the motor conduit compartment.
   d. Incorporate temperature switch operation with the motor control.
   e. Provide motor terminal box of adequate size to allow installation of motor terminal kits without interfering with terminals or damaging control wiring.

2. Stator Windings and Main Bearing Oil Reservoir RTDs.

   a. Equip the motor with 100-ohm platinum RTD installed in the stator windings (one per phase minimum) and in each main bearing oil reservoir.
   b. Connect the RTD leads to the terminals in the motor conduit box.
   c. Install temperature control relays in the motor controller compartment and incorporate with the motor controls.

I. **Shaft Seals** (as required in the individual pump specifications)

1. Split-Face Mechanical Seals.

   a. A temperature rating of 250 degrees Fahrenheit (° F.) or higher.

b. Hydraulically balanced.

c. Materials of Construction.

1) Seal Faces.

a) Clean Water. Carbon/silicon carbide.
b) Wastewater. Silicon carbide/silicon carbide or tungsten carbide/silicon carbide.

2) Hardware, Glands, and Sleeves. 316 stainless steel.

3) Elastomers. EPR, Viton.

4) Springs. Hastelloy C or Elgiloy.

d. Subject to compliance with the specifications, provide the seals from one of the following approved manufacturers.

1) Chesterton Type 442.
2) John Crane Type 3710.
3) Flowserve Type PSIII.

2. Cartridge Single Seals.

a. A temperature rating of 250° F. or higher.

b. Hydraulically balanced.

c. Materials of Construction.

1) Seal Faces.

a) Clean Water. Carbon/silicon carbide
b) Wastewater. Silicon carbide/silicon carbide or tungsten carbide/silicon carbide.

2) Hardware, Glands, and Sleeves. 316 stainless steel.

3) Elastomers. EPR or EPDM.

4) Springs. Hastelloy C.

d. Subject to compliance with the specifications, provide the seals from one of the following approved manufacturers.

1) Chesterton Type 155.
2) John Crane Type 5611.
3) Flowserve Type 84/85.

3. Throat Bushings.

    a. Provide a close-fit throat bushing as specified in individual pump specifications.

    b. Subject to compliance with the specifications, provide the bushings from one of the following approved manufacturers.

        1) Chesterton SpiralTrac.
        2) John Crane 24SL.
        3) Flowserve SEB.

4. Seal Environmental Controls.

    a. In accordance with API 682 except as noted.

    b. Standard Flushing Plan 11.

        1) Furnish flow control orifice as needed to control flow or pressure differential.

    c. Standard Flushing Plan 13.

        1) Furnish brass needle valve to control flow.
        2) Furnish pipe nipple and valve on second gland flush port to vent air from seal chamber before start-up.

    d. Standard Flushing Plan 32.

        1) Provide a seal monitoring system, minimum 3/8-inch check valve (unless included in the seal monitoring system), minimum 3/8-inch copper piping, two minimum brass 3/8-inch isolation ball valves, and all other required fittings and hardware for a complete system for each pump utilizing this flushing plan.

            a) Seal monitoring system.

            b) Flange or pump mounted.

            c) Unit shall include a pressure gauge with a range that is adequate for the application and an adjustable flow regulator.

            d) Maximum flow capacity of at least 40 gph.

            e) Maximum pressure capacity of at least 125 psi.

            f) Minimum 3/8-inch-diameter connections.

g) Subject to compliance with the specifications, provide a seal monitoring system from one of the following approved manufacturers.

(1.) Chesterton Flow Guardian S50.
(2.) John Crane Type SFP.
(3.) Flowserve Sealgard I.

2.4 FINISHES

A. **Exterior Surfaces**. Shop-prime and field-finish all surfaces exposed after installation in accordance with Section 09 90 00, "Painting," including motors and accessories unless specified otherwise.

B. **Inner Surfaces**. Shop-paint all surfaces in contact with liquids being pumped as a submerged surface under Section 09 90 00, "Painting," unless specified otherwise.

2.5 SOURCE QUALITY CONTROL

A. Shop Pump Test

1. Perform a routine production test on all pumps 2 hp and less.
2. Submit certified performance test data based on testing of pumps with identical designs to those being furnished for all pumps 3 hp to 25 hp, unless noted otherwise.
3. Submit performance test data based on testing of each pump furnished that is 30 hp and over, unless noted otherwise.
4. Perform performance tests in accordance with the Test Code of the HI except as modified herein, and demonstrate compliance with the operating conditions specified.
5. Notify and afford the Engineer the opportunity to witness the test on pumps larger than 100 hp.
6. Base the pump test acceptance criteria on HI Level "A" performance.

B. Motor Shop Tests

1. Tests shall be performed in accordance with ANSI/IEEE Standard 112 and ANSI C52.1, parts 12 and 20 (NEMA MG1).

    a. For every motor furnished under 30 hp, submit certified data.
    b. For every motor furnished 30 hp and larger and less than 200 hp, submit a routine test report and certified data.
    c. For every motor furnished 200 hp and greater, submit a full certified test report.

2. Test Report Requirements.

    a. Routine Test Report. Includes running light current, power input, and high potential based on test data from each motor furnished that requires it.

b. Certified Data. Includes motor efficiency and power factor at 100 percent, 75 percent, and 50 percent of full load based on test data of a motor of identical design.

c. Full Certified Test Report. Includes full-load heat run, percent slip, running light current, locked rotor current, starting torque, efficiency and power factor at 100 percent, 75 percent, 50 percent full load, and winding resistance and high potential tests based on test data from each motor furnished that requires it.

3. Notify and afford the Engineer the opportunity to witness any required Full Certified Tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Before installation of equipment, verify that:

1. All clearances have been met.
2. Bases, anchors, supports, and openings are located correctly and are of the proper size and material.

B. **Variations**. Correct any variations from the requirements shown or required by the manufacturer at no additional cost to the Owner. Submit all methods of correction in writing.

3.2 **PREPARATION**. Protect all surface areas from damage. Protect all finished floors with a waterproof, oil-resistant cover to prevent staining from oil and/or grease.

3.3 INSTALLATION

A. **General**. Install all pumps and components in accordance with the manufacturer's instructions and the conforming shop drawings, including all gasket seals, isolation dampeners, cleanouts, drains, gauges, motors, controls, and power wiring.

B. **Piping as shown** is typical for the specified pump. Actual pump piping connections may vary among pump manufacturers. Coordinate pump piping connections with pump supplier and piping supplier.

C. **Set anchor rods** in accordance with the approved manufacturer's conforming submittals.

D. **Lubrication**. Furnish and apply an initial supply of grease and oil as recommended by the manufacturer. Grease and oil the equipment throughout all testing until substantial completion.

E. **Base**. Anchor and grout the base in accordance with the manufacturer's recommendations. Connect base drain to nearest floor drain.

F. **Interface with Other Products**

1. Complete all electrical power and control connections under Division 26, "Electrical."
2. Paint the equipment in accordance with Section 09 90 00, "Painting."
3. Install and connect all piping.
4. Perform field quality control as specified in this specification.

3.4 **REPAIRS/RESTORATION**. Repair or replace any damage to the pump or motor or chips, dents, scratches, stains, or other disfiguring of surrounding floors, walls, and/or accessories to the satisfaction of the Owner and/or Engineer at no additional cost to the Owner.

3.5 **FIELD QUALITY CONTROL**

A. **Manufacturer's Field Service and Start-Up**

1. A qualified representative of each equipment manufacturer shall start up the pumps in accordance with Section 01 79 00, "Start-up, Demonstration, and Training," including all field testing.
2. Representative shall spend at least 1 day performing the required services for each type of pump.

B. **Noise and Vibration limitations.** For an acceptable installation, the pump and motor combination shall operate without excessive vibration, noise, or bearing temperatures, under the specified conditions. Guidelines to establish excessive pump vibration shall be as described in ANSI/HI 9.6.4.

C. **Visual**. The Contractor, Owner, and/or Engineer shall inspect the equipment for visual deficiencies.

1. Verify and certify pump, driver, and coupling for proper connections, lubrication, and mechanical suitability for operation per manufacturer’s recommendation.
2. Verify and certify baseplate and equipment for proper leveling, anchoring and grouting.
3. Verify and certify that connected pipe load does not exert thrusts on suction and discharge nozzles beyond allowable for pump size.
4. Verify and certify that all sensors and protective devices are operational and provide all needed protection for proper warrantee.
5. Compare equipment nameplate data with drawings and specifications.
6. Inspect physical and mechanical condition.
7. Inspect for correct anchorage, mounting, grounding, connection and lubrication.
8. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data. Perform thermographic survey.
9. When applicable, perform special tests such as air gap spacing and pedestal alignment.
10. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.

11. Verify proper installation, gapping and termination of all sensors provide as part of pump system.

D. **Pump Performance Testing**

1. Field testing shall be performed in accordance with the construction sequencing and constraint requirements of the project and CONTRACTOR shall notify the Owner in advance of said testing, in accordance with the requirements of Division 01. Field testing shall verify proper alignment, operation as specified and demonstrate harmful vibrations are not present.
2. Field testing shall include flow, suction and discharge pressure, process flow temperature, pump speed and pump vibration as described herein. The minimum run time for each pump test shall be determined by the pump manufacturer. Contractor shall clean and check lubrication of all parts in preparation for field testing and the grade of lubricant shall be in accordance to the manufacturer's standards.
3. Pump capacity versus TDH shall be determined for each pump along with current, voltage readings taken from each pump's respective motor and bearing temperatures.
    a. Develop a pump curve of head versus flow as specified herein and obtain at least six points on the pump curve. Determine pump brake horsepower at each operating point and provide a modified curve for each pump with a characteristic performance curve that operates acceptably over the system curve requirements.
    b. After starting the test, 10 minutes shall be given before readings commence. The pumps shall continue to run for a minimum of 48 consecutive hours per pump within which bearings temperatures shall stabilize within the first hour. At the conclusion of this test, all the readings shall be taken again and shall demonstrate stability. Record bearing temperatures during testing.
4. Provide temporary testing instrumentation as required. Devices shall be used in conjunction with installed permanent instrumentation, to provide independent verification of operating conditions as required by the Engineer and Owner.
    a. Instrumentation shall include, but not be limited to, pressure gauges, ammeters, and temperature monitoring devices.
5. Submit a field test procedure with proposed instrumentation for approval at least 30 days before the scheduled test date and CONTRACTOR shall provide the City with the test date two weeks prior to said test date.
6. Testing shall be sufficient to demonstrate successful operation of the pumping unit (pump manufacture's responsibility), as well as all related piping, valves, and electrical power supply and control systems (CONTRACTOR's responsibility).
7. Pumps, motors and electrical power and control system operation shall be demonstrated with the pump and motor uncoupled. Demonstration shall include, but not be limited to, functional testing of control system switches, relays, alarms and displays.

8. Successful operation shall be defined as demonstrating the pumping unit operates at or within the range of the specified operating parameters and is controlled in the manner described herein and Contract Documents.
9. Vibration testing shall be successfully completed during this period as described herein.

3.6 CLEANING

A. **In accordance with Section 01 74 23**, "Cleaning."

B. **Additional Requirements**

1. Clean the pump, motor, accessories, and surrounding areas of all foreign material, grease, and oil stains.
2. Remove all rags, sticks, debris, and construction materials. Replace damaged equipment components in like kind at no additional cost to the Owner.
3. After cleaning, provide protective covering for each piece of equipment.
4. All lubricants shall be drained and replaced prior to final acceptance. Cost of lubricants shall be paid by the CONTRACTOR and the grades of lubricants shall be in accordance with the manufacturer's standards.

3.7 CLOSEOUT ACTIVITIES

A. **Demonstration**. Perform an operational demonstration in accordance with Section 01 79 00.

B. **Training**. Conduct training in accordance with Section 01 79 00 and as required in the individual pump sections.

3.8 PROTECTION

A. **Requirements**

1. Be responsible for provisions to protect the pumps and materials after installation, but before acceptance by the Owner.
2. Protection of the equipment shall include provisions during installation and testing of nearby piping, valving, or other adjacent equipment.
3. Remove all protective measures installed after acceptance of the project.

END OF SECTION

SECTION 43 21 10

PUMPS, NON-CLOG

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 43 21 00, "Pumps, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. In accordance with Section 43 21 00, "Pumps, General."

1.3 **QUALITY ASSURANCE**. In accordance with Section 43 21 00, "Pumps, General."

1.4 **SUBMITTALS**. Submit each of the following submittal packages in accordance with Section 43 21 00, "Pumps, General," and this section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

B. **Submittal Package No. 2 – Source Quality Control Documents**

C. **Submittal Package No. 3 – Start-up Preparation Documents**

D. **Submittal Package No. 4 – Operational Demonstration Preparation Documents**

E. **Submittal Package No. 5 – Operational Demonstration Documents**

F. **Submittal Package No. 6 – Extra Materials or Spare Parts**

1. Schedule. These must be submitted before the equipment can be considered substantially complete.

2. Submittal Package Contents. Submit one set of spare parts as described below for each model of pump supplied.

a. One complete set of mechanical seals.
b. One complete set of bearings.
c. One complete set of gaskets and O-rings.
d. One impeller wear ring.
e. One case wear ring.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 43 21 00, "Pumps, General."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **NONCLOG PUMPS**. In accordance with Section 43 21 00, "Pumps, General."

A. **Manufacturer**. Subject to compliance with the specifications, provide the nonclog pumps from one of the following approved manufacturers.

1. Cornell
2. Fairbanks Nijhuis.
3. Flowserve.
4. ITT/AC.
5. Yeomans
6. Or equal.

B. **Description**. Centrifugal, nonclog, horizontal or vertical as shown, with a flexible coupling.

C. **Materials**

Part	Material
Casing and Suction Elbow/Head	Cast iron
Wearing Rings	400 series stainless steel
Air Release Cock	Bronze
Impeller	Cast iron
Bearing Housing	Cast iron
Base	Steel or cast iron
Shaft	Heat-treated high-carbon steel
Shaft Sleeve	Type 316 stainless steel

D. **Fabrication and Assembly**

1. Casings.

a. Impeller can be removed without disturbing piping connections.
b. Provide replaceable wearing rings that are at least 50 Brinnell harder than the impeller wear ring.
c. Tap and fit the top of the casing with a 1/2-inch threaded air release cock.

2. Impellers.

a. Single-suction, two- or three-vane, enclosed type, designed with large, smoothly contoured passages capable of passing the solid size listed in the Equipment Schedule.
b. Provide the impeller with replaceable wearing rings.

3. Bearings.

a. Outside the pump casing.
b. Include provision for axial adjustment of impeller clearances.

4. Base.

   a. For horizontal units, mount the pump and drive on a common base to form a rigid unit in the configuration shown.
   b. For vertical units, provide a fabricated pump support or a support cast integrally into the casing and/or suction head, and a separate fabricated motor support.

5. Suction Elbow (for vertical configuration only).

   a. Each suction elbow/head shall have a hand hole with removable cover.
   b. The interior surface of the cover should be flush with the surface of the suction elbow/head.

6. Shafts.

   a. Protected from wear by a replaceable sleeve which is locked to the shaft.
   b. Extend the sleeve through the stuffing box and seal it to prevent leakage under the sleeve.

2.2 **MOTORS**. In accordance with Section 43 21 00, "Pumps, General."

2.3 **ACCESSORY PRODUCTS**. Accessories for each pump specified in this section shall include the following items all in accordance with Section 43 21 00, "Pumps, General."

A. Anchor Rods

B. Coupling

C. Drain Piping

D. Pressure Gauges. Furnish and install a gauge on each pump suction and discharge.

E. Suction Hand Hole Reducer

F. Thermal Motor Protection

G. Shaft Seals

1. Provide one of the following mechanical seals.

   a. On shaft sizes greater or equal to 2.5 inches, provide a split face seal with a throat bushing.
   b. On shaft sizes less than 2.5 inches, provide a cartridge single seal with a throat bushing.

2. Provide seal water per Standard Flushing Plant 32 as detailed in Section 43 21 00, “Pumps, General”

2.4 **FINISHES**. In accordance with Section 43 21 00, "Pumps, General."

2.5 **SOURCE QUALITY CONTROL**. Shop tests in accordance with Section 43 21 00, "Pumps, General."

PART 3 - EXECUTION

3.1 **GENERAL**. In accordance with Section 43 21 00, "Pumps, General."

3.2 **FIELD QUALITY CONTROL**. Perform manufacturer's field service and start-up for each pump.

3.3 **CLOSEOUT ACTIVITIES**

A. **Perform a 30-day operational demonstration** of the pumps.

B. **Provide a total of 4 hours of training** that can be divided into as many as two different sessions on two different days as directed by the Owner.

3.4 ATTACHMENTS

A. Equipment Schedule

System Name	Filter-To-Waste (F-T-W)
Quantity	1 (Vertical)
Location	Filter Pipe Gallery
Minimum Solid Size Diameter (in)	1.5
Minimum Piping Connection Size (in)	6
Liquid Being Pumped (Sewage, Sludge, Potable Water, etc.)	Filtered Water
NEC Area Classification (Explosionproof, Unclassified)	Unclassified
Percent Solids in Liquid (%)	<1%
Environment (Exposed, Submerged, Outdoors, etc.)	Indoors
Maximum Operating Speed (rpm)	1,200
Maximum Motor Horsepower (Hp)	10
Motor Voltage (volts)	460
Phase (Single or Three)	Three
Duty (Variable or Constant Speed)	Constant
Motor Enclosure type (TENV, WP-1, etc.)	TEFC
Minimum peak pump efficiency (%) at Condition Two	75%
Condition One - Capacity (gpm)	600
Condition One - Head (ft)	40
Condition One - NPSHA (ft)	36
Condition Two - Head (ft)	25
Condition Two - NPSHA (ft)	Ample
Condition Three - Capacity (gpm)	300
Condition Three - Head (ft)	26
Condition Three - NPSHA (ft)	Ample

The pump and piping layout shown on the bidding plans are based on one pump manufacturers pump configuration and suction and discharge size. Contractor is responsible for any changes in piping, fittings and layout to suit the pump manufacturer selected for the bid.

Conditions One through Three are defined in paragraph 2.1 C.3 of Section 43 21 00, "Pumps, General."

END OF SECTION

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SECTION 43 21 14.01

PUMPS, VERTICAL TURBINE PUMP REHABILITATION FOR THE WELLFIELD PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 43 21 00, "Pumps, General"; and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Summary of Work.** This specification section describes the responsibilities and work to be performed by each party under their respective contract, including equipment, materials, handling, transporting, and startup. The General Contractor shall retain Ohio Drilling, hereinafter referred to as the Pump Service Contractor, to complete the work at the ten wellfield pumps at the Sugar Creek Water Treatment Plant Wellfield. The work to be provided includes the following:

1. The General Contractor shall be responsible for coordinating the work performed by the Pump Service Company and Electrical Subconsultant to refurbish the Wellfield Pumps. The General Contractor shall assist with testing, start-up and commissioning of piping, valves, equipment, instrumentation, and controls required for the operation of the pumps.
2. The General Contractor will be responsible for the removal of piping and valves for all ten (10) wells from the existing pump to the point where it connects to the existing raw water transmission mains as shown on the Contract Drawings. All necessary site excavation and demolition shall be completed to allow the Pump Service Company to perform its work to remove the well pumps and lower the outer casing pipe of the ten (10) wells.
3. The General Contractor shall coordinate with the Pump Service Company to perform the scope of work as briefly described herein and outlined in Appendix IV.
4. The Electrical Subcontractor shall provide assistance related to the removal, reinstallation, testing and commissioning of the pump(s) and motor(s) power and controls that are removed, repaired, and reinstalled for all ten (10) wells.
    a. Since the new underground 5 KV service may not be operable when the work on the well rehabilitation starts, it may be necessary for the Electrical Contractor to furnish and install temporary poles and relocate the existing electrical service, motor starter, SCADA panel. Conduit and wiring to operate the ten (10) well pumps using the existing overhead 5 KV service, and then remove all temporary systems once the new 5 KV underground power, transformer, and hookup of the new MCC, SCADA Panel, I&C, conduit, and wiring are installed and operational.

B. **Work included under this Specification Section.**

1. Wellfield Pumps
    a. The Pump Service Company shall remove each of the ten (10) well pumps and properly store on-site until ready to be re-installed after the casing height has been reduced to the elevations shown on the drawings, and the pump base plates installed to re-install the well pumps.
    b. The General Contractor shall remove the existing valve vaults for Wells 1 through 7 including piping and valves from the pump to the raw water transmission mains. Discharge piping from Wells 8 through 10 shall be removed from the pump up to the existing raw water mains as shown on the Contract Drawings, including the piping in these three (3) valve vaults. The three (3) vaults shall be backfilled to allow for construction of the new well building foundations as shown on Contract Drawings. Wells 8 and 9, casings are sinking, and a new steel-framed cross bracing system shall be provided by the Pump Service Company to support the weight of the pump, motor and casing. Well 10 has a cross-bracing system that will be removed and modified by the Pump Service Company to accommodate the lowering of the pump casing and new discharge piping.
    c. Each of the ten (10) vertical turbine well pumps has a cast discharge head for mounting the motor and a 10” or 12” discharge flange that is currently fitted with a blind flange that is used for cleaning the pumps. The Pump Service Company shall cut off the existing 10” or 12” discharge flange below grade and weld a new plate to the existing column to seal off the opening in the pump column.
        1) When reinstalling Well Pumps 1 through 6, the discharge of the pump shall be rotated to face east. Well Pump 7 shall be installed to face north. The existing discharge head of the Well Pumps 8 through 10 shall be installed to face east.
    d. The General Contractor shall construct a new well building at each of the ten (10) wells including providing excavation, backfill, concrete foundations, and metal-sided building as shown on Contract Drawings.
    e. For each of the ten (10) wells, the General Contractor shall install new air-vacuum relief valves, solenoid operated drain valves, piping, valves, magnetic flow meter, and pipe couplings on each pump, a 12” x 8” fitting with valve shall be installed on each pump discharge for bypass operation during the cleaning of wells. The new discharge piping shall be re-routed from the well building to the existing and/or new raw water transmission mains as shown on Contract Drawings.

2. Pump Service Company shall provide labor, tools, and equipment to remove and reinstall pump, lower casing pipe, install new base plate on outer casing and weld to inner casing pipe, install new inner casing

extension and foundation plate for each well pump drilled to match bolt circle pattern for re-attaching pump head to foundation plate. Install stiffeners on inner casing pipe extension, cut and weld 6" gravel fill tube on outer casing pipe that extends above the concrete pad surrounding the well, and cut and weld a 2" level control insert tube in the side wall on inner casing show on drawings.

3. Pump Service Company shall provide shoring and bracing to support outer pump casing pipe after the General Contractor has demolished valve vault and excavated site to rough grade, exposing well outer casing.
4. Pump Service Company shall remove pump motor and pump discharge head assembly and store on-site in safe location under weatherproof cover.
5. Pump Service Company shall perform the following:
    a. Mark outer casing pipe with proper elevation to mount 42" x 42" x 1.25" base plate. Base plate shall have inner circle cut out to weld base plate to sidewall on inner casing pipe. Cut and grind outer casing for mounting base plate atop outer casing, level, and weld into place.
    b. Cut and/or grind inner casing pipe to mount inner casing extension pipe atop old inner casing pipe. Provide inner casing pipe extension so that pump foundation plate is at proper elevations. The inner foundation plate shall be drilled to match bolt pattern of pump with holes properly aligned so discharge of pump is oriented correctly. Weld pump foundation plate to extension pipe.
    c. Weld stiffeners to side of inner casing pipe outer wall, and underside of foundation plate and top of outer casing base plate. Check the foundation plate is plumb.
    d. Reinstall pump column in inner casing. Bolt pump head to threaded and tapped holes in foundation plate that match bolt size and patter of discharge head.
    e. Cut opening inside wall of inner pipe extension to be used for installation of for 2" pipe for level control insertion.
    f. Cut 6" opening in ide wall of outer caging for installation of 6" gravel fill line, and weld to outer casing pipe, and extend so cap is located above final grade of concrete pad surrounding well pump
    g. Reinstall motor and assist in start-up and commissioning of pump. discharge head.
6. The General Contractor shall clean site of all construction debris.

C. **Work NOT included under this Specification Section:**

1. Pump inspection and repairs are not included under this Contract. The well pumps are inspected, repaired, and the well screens cleaned on an on-going five-year cycle.
2. If any pump deficiencies are noted when the pump is removed, the Owner shall be notified, and a work order may be issued by the Owner / Engineer if additional teardown of the pump is required for inspection, cleaning, repairs, or part replacement. This work is not part of the

original scope of work and will performed under a separate contract unless covered by a separate work order authorization to be paid for by change order to this contract.

1.3 QUALITY ASSURANCE

A. **In accordance with Section 43 21 00**, "Pumps, General."

1.4 SUBMITTALS

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Schedule and Work Plan. No other submittal packages related to this equipment can be approved before a schedule and work plan is submitted and approved.

2. Submittal package contents
   a. Product Data.
   b. Shop Drawings.

1.5 JOB CONDITIONS

A. **Coordination with Other Work.** Coordinate the scheduling of the work with WTP management and staff. Coordinate pump and motor removal with WTP maintenance staff. Have all materials needed to install blind flanges on hand, identify the location of equipment, piping, and conduit to prevent interferences and delays.

B. **The General Contractor** shall provide a work plan for each well and identify any short-term (under 48 hours) or long-term outages needed to complete the work at each well.

C. **Limits to Number of Well Pumps Out of Service.** The General Contractor shall schedule work to maintain an average daily flow of 10.5 MGD to the Sugar Creek Water Treatment Plant. Only one of Wells 8, 9, and 10 can be taken out of service at a time, and not more than one large and one small or 2 small wells can be taken out of service at any time.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General**. Delivery, storage, and handling of equipment shall be in accordance with Section 01 60 00, "Materials and Equipment" and Section 43 21 00, "Pumps, General."

1.7 SPECIAL WARRANTY

Not used.

PART 2 **- PRODUCTS**

2.1 **MATERIALS**

A. **Related Sections.**

1. The General Contractor, Pump Service Company, and Electrical Contractor shall furnish all materials and equipment used for refurbishing the wellfield pumps in accordance with the requirements of other sections of this Specification Section 1 – 46.

B. **Spare Parts.** Not Used

PART 3- EXECUTION

3.1 **GENERAL**

A. **In accordance with Section 43 21 00**, "Pumps, General."

B. **Cleaning and Tagging.** Any item that has been in service and needs removed MUST be cleaned PRIOR to storing temporarily in order to make modifications to the existing well casings as shown on the detailed plans.

1. Items need to be tagged with pump number, pump model and serial number. Tag MUST include type of media the item was installed in, along with the cleaning method used. Tag MUST also include company name, date cleaning was completed and signed by the person that cleaned the item.
2. For each wellfield pump that is removed, a wash down (with disinfectant) should be completed PRIOR to the Pump Service Company reinstalling.

C. **Mechanical Work**. The General Contractor shall coordinate with Owner/Engineer to schedule removal of selected pump, including disconnecting piping, removing pump head, motor, shafting (if needed) and pump foundation plate. The Contractor shall furnish labor, materials, equipment, and tools to remove, load, and store the pumps temporarily. When work is complete re-install pump, motors, reconnect piping, and assist with testing and start-up.

D. **Electrica**l **Work**. An electrician shall be responsible for disconnecting power and controls to each pump, securing wiring, and when pump is return to be re-installed, assist with reconnecting power and controls to make pump operational.

E. **Start-up and Commissioning:** Provide two (2) trips to site per pump by a Pump Service Company field technician to inspect installation pump and motor, and to witness testing and commissioning pump after the installation is complete.

PART 4– EQUIPMENT INFORMATION

4.1 Wellfield Existing Information

Number of Wells	10
Well #1-4 and 6 Capacity:	American Marsh 14 LC (2- Stage) 2.50 MGD each
Well #5 Capacity:	American Marsh 12 WC (2-Stage)1.50 MGD each
Well #7 Capacity:	Hydroflow 14HH (2-Stage) 2.50 MGD each
Well #8-10 Capacity:	American Marsh 14 HC (2- Stage) 4.75 MGD each
Well #1 Pump Data:	1,750 gpm @ 163'TDH, 100 HP, 480V, 3 PH
Well #2 Pump Data:	1,750 gpm @ 171' TDH, 100 HP, 480V, 3 PH
Well #3 Pump Data:	1,750 gpm @ 171' TDH, 100 HP, 480V, 3 PH
Well #4 Pump Data:	1,750 gpm @ 151' TDH, 100 HP, 480V, 3 PH
Well #5 Pump Data:	1,050 gpm @ 120' TDH, 75 HP, 480V, 3 PH
Well #6 Pump Data:	1,050 gpm @ 110' TDH, 75 HP, 480V, 3 PH
Well #7 Pump Data:	1,750 gpm @ 160' TDH, 100 HP, 480V, 3 PH
Well #8 Pump Data:	3,325 gpm @ 160' TDH, 125 HP, 480V, 3 PH
Well #9 Pump Data:	3,325 gpm @ 160 'TDH, 125 HP, 480V, 3 PH
Well #10 Pump Data:	3,325 gpm @ 160' TDH, 125 HP, 480V, 3 PH
Total Capacity	25 MGD w/ largest unit out of service

(Note: New VFDs will be installed on Wells #2, 4, and 9.)

Well Casing Size and Length:

Well Number	Pump Discharge Length,	Pump Column/ Discharge	Screen Length	Size Casing Outer	Size Casing Inner	Well Depth (Existing)
Well 1	88'	10" x 10"	70'	38"	26"	142.6'
Well 2	79'	10" x 10"	80'	38"	26"	152.6'
Well 3	103.5'	10" x 12"	80'	38"	26"	152.6'
Well 4	88'	10" x 10"	80'	38"	26"	152.6'
Well 5	67.5	10" x 10"	80'	38"	26"	152.6'
Well 6	N.A.	10" x 10"	80'	38"	26"	152.6'
Well 7	77.83	12" x 12"	80'	36"	26"	153.8
Well 8	59.25	12" x 12"	100'	36"	26"	250.0
Well 9	112.83	12" x 12"	100'	36"	26"	250.8
Well 10	112.83	12" x 12"	100'	30"	26"	250.2

END OF SECTION

SECTION 43 21 14.02

PUMPS, VERTICAL TURBINE PUMP REHABILITATION FOR THE HIGH SERVICE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 43 21 00, "Pumps, General"; and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Summary of Work.** This specification section describes the responsibilities and work to be performed by each party under their respective contract, including equipment, materials, handling, transporting, and spare parts. The General Contractor shall retain Ohio Drilling, hereinafter referred to as the Pump Service Contractor, to provide pump rehabilitation of the five (5) High Service Pumps at the Sugar Creek Water Treatment Plant. The work to be provided includes the following:

1. The General Contractor shall be responsible for coordinating the work performed by the Pump Service Company and Electrical Subconsultant to refurbish the High Service Pumps. The General Contractor shall be responsible for coordinating his work to remove and install new piping and valves with the Pump Service Company, and shall assist with testing, start-up and commissioning of piping, valves, and equipment required to for the operation of the pumps.
2. The General Contractor shall coordinate scheduling any planned outages to perform the work on the High Service Pumps by the Pump Service Company only after a work plan has been submitted and approved by the Owner and Engineer.
3. During construction, only one (1) High Service Pump can be taken out of service at time, and work in the High Service Pump Station (HSPS) clearwell work shall be limited to no more than 48 hours before being returned to service unless addition downtime is allowed by the Owner. In no case shall the finished water pumping rate be less than seven (7) MGD while one clearwell is out of service.
4. The General Contractor shall coordinate with the Pump Service Company to perform the scope of work as briefly described herein and outlined in Appendix IV.
5. The Pump Service Company shall be responsible for shipping to and from the site and handling the existing motors being refurbished.
6. The Electrical Subcontractor shall provide assistance related to the removal, reinstallation, testing and commissioning of the pump(s) and motor(s) power and controls that are removed, repaired, and reinstalled. Running new conduit and wiring for power and controls, and re-terminating, reconnecting, testing, and providing assistance with commissioning the refurbished pump and motors.

B. **Work included under this Specification Section.**

1. High Service Pump No. 1 was recently rebuilt by the Pump Service Company. The pump motor has been rebuilt and the pump discharge head was replaced with a new casting assembly. The only work required on High Service Pump No. 1 is related to providing power to the unit, including relocating and installing new Power Factor Units and replacing conduit and wiring as show on the drawings.
2. The Electrical Subcontractor shall work with the Pump Service Company and assist with the removal of the pump motors. The Pump Service Company is responsible for loading, transferring, shipping, unloading the rebuilt motors to and from the site, and reinstallation of the motor when they return from the motor rebuilder.
3. The Pump Service Company shall perform the following:
    a. High Service Pump Motors No. 2 through 5
        1) Rebuild Motors High Service Pumps No. 3, No. 4, and No. 5. The motors shall be disassembled, cleaned, and inspected, and any deficiencies reported. Each motor shall be tested including megger testing of motor winding, installation of new thermal overload switches, installation of new RTDs, and replacement of the inboard and outboard bearing assemblies.
            a) High Service Pump No. 2 through shall be removed and shipped to and from an approved motor rebuilding by the Pump Service Company. Removal of Higher Service Pump motors for pumps No. 2 through 5.
            b) The motor shall be cleaned, tested, and reassembled. A report shall be provided summarizing the work performed, parts list, and recommended spare parts for each motor.
            c) The rebuilt motors shall be loaded and returned to the site and reinstalled on the new pump discharge head by the Electrical Contractor with the assistance of the Pump Service Company to make the final connections and align the pump and motor before testing the unit for proper operation.
            d) For High Service Pump No. 2 only, the Pump Service Company shall procure a new 250 HP, 1200 rpm, 480-volt induction motor shall be provided, and powered by a new variable frequency drive (VFD) including new conduit and wiring.
            e) Reinstall the motors for High Service Pumps No. 2 through 5.
    b. Rebuild High Service Pumps No. 2 through 5.
        1) The pump discharge heads for the existing High Service Pumps No. 2, No. 3, No. 4, and No. 5 are corroded and shall be replaced with new units that match the same overall dimensions of the existing unit. Rebuild High

Service Pumps No. 2, No. 3, No. 4, and No. 5 that includes, but not limited to, pulling the pump, shipment, cleaning, inspection, rotating the impellers, new bearings, new RTDs, new discharge head/stand, and reinstallation of both the pump and motor.

4. The Electrical Subcontractor shall be responsible for all electrical work related to disconnecting and reconnecting the High Service Pump motors being rebuilt for High Service Pumps No. 2 through No. 5, controllers, a new Variable Frequency Drive for High Service Pump No. 2, motor controls, and re-installing refurbished and new motors. Running new conduit and wiring for power and controls, and re-terminating, reconnecting, testing, and providing assistance with commissioning the refurbished pump and motors.

1.3 QUALITY ASSURANCE

A. **In accordance with Section 43 21 00**, "Pumps, General."

1.4 SUBMITTALS

A. **General**

1. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Schedule and Work Plan. No other submittal packages related to this equipment can be approved before a schedule and work plan is submitted and approved.

2. Submittal package contents

a. Product Data.
b. Shop Drawings.

C. **Submittal Package No. 2 – Extra Materials or Spare Parts**

1. Submittal package contents

a. A list of recommended extra materials or spare parts for wear elements in the pump, including list prices, including any spare parts to be provided with pump and motor rehabilitation as specified later in this specification section.

1.5 JOB CONDITIONS

A. **Coordination with Other Work.** Coordinate the scheduling of the work with WTP management and staff. Coordinate pump and motor removal with WTP maintenance staff. Have all materials needed to install blind flanges on hand, identify the location of equipment, piping, and conduit to prevent interferences and delays.

B. **Limits to Number of High Service Pumps Out of Service and Clearwell Work Requirements.** During construction, only one High Service Pump can be taken out of service at time, and work in the HSPS clearwell work shall be limited to no more that 48 hours before being returned to service unless addition downtime is approved by the Owner/Engineer. In no case shall the finished water pumping rate be less than 7 MGD while one clearwell is out of service.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. Delivery, storage, and handling of equipment shall be in accordance with Section 01 60 00, "Materials and Equipment" and Section 43 21 00, "Pumps, General."

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 **- PRODUCTS**

2.1 **MATERIALS**

A. **Related Sections.**

1. The General Contractor, Pump Service Company, and Electrical Contractor shall furnish all materials and equipment used for refurbishing the wells in accordance with the requirements of other sections of this Specification Section 1 – 46.

B. **Coating**.

1. Impellers. Remove and coat the existing impellers with Belzona 1341 Supermetalglide metallic polymer or equal.
2. Casing. Coat the existing casing of the pump with Belzona 1341 Supermetalglide metallic polymer or equal.

C. **Spare Parts.** Not used.

PART 3- EXECUTION

3.1 **GENERAL**

A. **In accordance with Section 43 21 00**, "Pumps, General."

B. **Cleaning and Tagging.** Any item that has been in service and needs repairs MUST be cleaned PRIOR to transporting pumps to the pump service facility by the Contractor under supervision of the Engineer.

1. Items need to be tagged with pump model and serial number. Tag MUST include type of media the item was installed in, along with the cleaning method used. Tag MUST also include company name, date cleaning was completed and signed by the person that cleaned the item.

2. For any item used, a wash down (with disinfectant) should be completed PRIOR to transporting to the Pump Service Company facility and detailed with returned item.

C. **Mechanical Work**. The General Contractor shall coordinate with the Owner/Engineer to schedule removal of selected pump, including disconnecting piping, removing pump, motor, shafting (if used) and pump stand/frame, plate. The Pump Service Company shall furnish labor, materials, equipment, and tools remove, load, ship pumps to and from the motor rebuild facility. Pump Service Company shall re-install pump, motors, reconnect piping, and assist with testing and start-up.

D. **Electrica**l **Work**. An electrician shall be responsible for disconnecting power and controls to each pump, securing wiring, and when pump is return to be re-installed, assist with reconnecting power and controls to make pump operational.

E. **Start-up and Commissioning:** Provide two (2) trips to site per pump (8 total) by a Pump Service Company field technician to inspect re-installation of pump and motor, and to witness testing and commissioning pump after the installation is complete.

PART 4– EQUIPMENT INFORMATION

4.1 High Service Pumps Existing Information

Number of Pumps:	5
Type:	Horizontal Vertical Turbine (Peerless)
Capacity Pump #1 and #5 (1960)	4,630 gpm (6.67 MGD) @ 320‘ TDH
Pump #3 (1970)	450 HP, 1200 rpm, (6.67 MGD), 320’ TDH 24 MA Bowl, 4-stage, 16 x 16 x 30.5 FA Head Unit
Capacity Pump #2 (New Motor Only)	2,315 gpm (3.33MGD) @ 250’ TDH, 250 HP, 1200 rpm, 480-volt, Induction Motor 16HXB Bowl, 10-stage,1 2 x 12 x 30.5 FA Head
Capacity Pump #4 (1997)	4,630 gpm (6.67 MGD, 320’ TDH 500 HP, 1200 rpm, 4,160-volt, Induction Motor, 1997 24 MA Bowl, 4-stage, 16 x 16 x 30.5 FA Head Unit
Total Capacity	16,205 MGD (23.35 MGD) w/ largest unit out of service
VFDs:	1 (On Pump 2)

END OF SECTION

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SECTION 43 24 13

PUMPS, VERTICAL TURBINE

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 43 21 00, "Pumps, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. In accordance with Section 43 21 00, "Pumps, General."

1.3 **QUALITY ASSURANCE**. In accordance with Section 43 21 00, "Pumps, General."

A. The CONTRACTOR shall assign unit responsibility to the pump manufactured provided under this section. All mechanical equipment component of this entire equipment assembly shall be furnished by the pump manufacturer that includes, but no limited to, equipment assembly specified and all other equipment assembly components specified.

B. Operating Characteristics:

1. The design points specified herein shall be located within the Preferred Operating Region as established by the pump manufacturer in accordance to ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specified model proposed for this application.
2. The pump, bearings, shaft and other components shall be sized for and capable of handling the maximum torque generated by the motor needed for the largest impeller diameter for the pump casing.
3. Direction of rotation for each pump and motor shall be as indicated on the Contract Drawings for proper direction of flow.
4. Overall vibration levels (peak velocity) at the shaft baring housing shall not exceed the limits listed in ASNI/HI 9.6.4 over the pump's entire range and speed of flow.
5. The pumps and driver shall be capable of being started and stopped intermittently up to three (3) starts per hour. Pump suction and discharge sizes are shown on the drawings. Other sizes may be accepted at no additional cost to the Owner and approved by the Owner.

C. All materials in contact with water shall meet NSF Standard 61, as required by Ohio Administrative Code Rule 3745-83-01(D).

1.4 **SUBMITTALS**. Submit each of the following submittal packages in accordance with Section 43 21 00, "Pumps, General," and this section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

B. **Submittal Package No. 2 – Source Quality Control Documents**

C. **Submittal Package No. 3 – Start-up Preparation Documents**

1.

D. **Submittal Package No. 4 – Operational Demonstration Preparation Documents**

E. **Submittal Package No. 5 – Operational Demonstration Documents**

F. **Submittal Package No. 6 – Extra Materials or Spare Parts**

1. Schedule. These must be submitted before the equipment can be considered substantially complete.
2. Submittal Package Contents. Bottom case bearing series case gasket, upper bearing, line shaft bearing assembly, impeller lock collet, head shaft, seal, stuffing box gasket, stuffing box bushing. Spare Parts shall also include the following:
   a. One (1) set of all pump bearings that include the lower bearing assembly, upper bowl bearing, and line shaft bearing assemblies.
   b. One (1) set of gaskets and O-rings.
   c. One (1) head shaft.
   d. One (1) Impeller Key.
   e. One (1) mechanical seal.
   f. One (1) set of wearing rings.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 43 21 00, "Pumps, General."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **VERTICAL TURBINE PUMPS**. In accordance with Section 43 21 00, "Pumps, General."

A. **Manufacturer**. Subject to compliance with the specifications, provide the vertical turbine pumps from one of the following approved manufacturers.

1. American Marsh.
2. Simflow.
3. Fairbanks Nijhuis.
4. Floway.
5. Flowserve.
6. Peerless.

B. **Description**. Water-lubricated, short-coupled vertical turbines.

C. **Materials**

Part	Material
Discharge Head	Steel
Base Plate	Steel
Top Shaft	416 series stainless steel
Sleeve Bearing	Bronze

Column	ASTM* A 53 steel
Line Shaft	400 series stainless steel
Line Shaft Couplings	400 series stainless steel
Bowls	Porcelain-enameled cast iron
Strainer	Bronze or 316 Stainless Steel
Impellers	Bronze
Locking Collet	400 series stainless steel
Impeller Shaft	416 series stainless steel
Impeller Shaft Bearings	Bronze
Line Shaft Bearings	Rubber sleeve type secured by carbon steel retainers integral to column pipe.

*ASTM – American Society for Testing and Materials

D. **Fabrication and Assembly**

1. Discharge Head.

    a. The discharge head shall be fabricated with large hand holes for seal adjustments.
    b. The head shall be designed to withstand the full shutoff head of the pumps.
    c. Provide tap on discharge for installing accessory pressure gauge.
    d. Machine the driver mounting flange to National Electrical Manufacturers Association (NEMA) standards.
    e. Discharge nozzle shall be equipped with a vertical vane to minimize turbulence.
    f. The discharge head shall be mounted on steel plate of sufficient size to support the equipment.
    g. Shall be equipped with a pre-lube port.

2. Base Plate. Mount the discharge head on a base plate set in concrete. The plate shall be a minimum thickness of 1 inch and include lifting lugs to support the weight of the entire unit.

3. Top Shaft. The solid top shaft shall be two pieces joined to the line shaft with a shaft coupling. The top shaft shall extend through the hollow shaft of the motor and have an adjusting nut for impeller adjustment.

4. Stuffing Box. Stuffing box assembly shall include a sleeve bearing to support the top shaft and equipped for a mechanical seal.

5. Column.

    a. Shall be Steel er ASTM A53 with pipe sections joined by flanges.
    b. The top and bottom sections of the column pipe shall be 5 FT lengths with intermediate sections not exceeding 10 FT in length.

Column pipe sections shall have a nominal length not exceeding 10 feet.

c. The column shall be coated with a epoxy system at the factory as recommended by Tnemec or Koppers and approved for used with potable water.

d. The column size shall be such that the friction loss shall not exceed 5.0 feet per 100 feet with a roughness coefficient of C = 120 in the Hazen Williams head loss formula, and the velocity shall not exceed 10 feet per second at design capacity.

6. Open Line Shaft.

a. Furnish in interchangeable sections not over 5 feet in length.

b. Machine square the butting faces to the axis of the shaft.

c. Maximum permissible total indicated runout of the shafts is 0.004 inch in 12 inches.

d. The size of the shafts shall be no less than the minimum shaft diameter required by AWWA E103 and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls.

e. Couplings, with 1-1/2 times greater strength than the shaft, shall join the line shafts.

f. Threads shall be left hand to tighten during pump operation.

7. Suction Inlet and Strainer.

a. Equip the suction inlet with a flared fitting and a basket-type strainer.

b. The net inlet area of the strainer shall be at least four times the suction pipe area and the maximum opening shall be no more than 75 percent of the minimum opening of the water passage through the bowls and impellers.

c. The suction inlet shall be designed to reduce entrance loses with enough vanes to support lower guide bearings and weight of impeller and shaft when dismantling the pump.

8. Impellers.

a. Enclosed type.

b. Securely fastened to the impeller shaft with a tapered bushing or locking collet.

c. The impeller shall be accurately fitted and statically and dynamically balanced.

d. Provide bronze replacement wear rings in each bowl to prevent wear on the bowls.

9. Bearings.

a. Support the impeller shaft with sleeve-type bearings above and below each impeller of a size and length to support against any radial load.
b. The length of the top and bottom bearings shall be at least two and a half times the shaft diameter.
c. Provide the bearings in the suction case with mechanical seals, collars, and other devices to exclude sand and grit from the bearings.
d. Lined shaft bearings shall be lubricated with the pump liquid and located at each column flange.

2.2 **MOTORS**

A. **General**

1. In accordance with Section 43 21 00, "Pumps, General."
2. Vertical solid shaft with a spacer coupling, WP-1, high-thrust type, premium efficient motor.
3. Thrust bearing sized to accommodate max pump thrust at any point of performance curve including closed valve condition or max down thrust condition.
4. The thrust bearing shall have the capacity to carry the weight of all the rotating parts plus the hydraulic thrust of the pump impellers with a safety factor.
5. Equipped with a non-reverse mechanism to prevent reverse rotation as water empties from the discharge column.
6. All copper windings.
7. NEMA Class “F” Insulation, Temp 40 C, Temp rise at 1.00 SF 80 C
8. Temperature Rise Class B @ Service Factor of 1.15
9. 120 volt space heaters.
10. Three motor winding thermostats
11. Two Bearing Temperature thermocouples if applicable
12. Motor Frame Size 5008PZ
13. Minimum 1-1/2” Steel Base Plate drilled for mounting to steel base plate on pump column stand or pump column floor plate.
14. Adaptor and/or shaft coupling designed to mate motor shaft to pump shaft.
15. Motor shaft shall allow removal of the mechanical seal for repair.
16. Motor Manufacturer. Ideal Electric Div. Hyundai, US Motors Div. of Emerson Motor Technology, General Electric, or Equal.

2.3 **ACCESSORY PRODUCTS**. Accessories for each pump specified in this section shall include the following items, all as specified in Section 43 21 00.

A. **Anchor Rods** (to be provided by Contractor if not furnished by pump manufacturer)

B. **Coupling** (to be provided by Contractor if not furnished by pump manufacturer)

C. **Seal Water and Drain Piping.** Furnish min. ½” copper tubing bearing seal/flush water to upper thrust bearings from factor installed connections to pump column discharge head, or field installed to extended to ½” NPT tap in discharge piping

of the pump located prior the electric ball check valve (to be provided by Contractor if not furnished by pump manufacturer).

D. **Pressure Gauge**. Furnish and install a gauge on each pump discharge if required (to be provided by Contractor if not furnished by pump manufacturer).

E. **Motor Winding Thermal Motor Sensing Protection.** Provide a thermostat with normally close contact embedded in each of the three motor windings.

F. **Shaft Seals**

1. Provide one of the following mechanical seals.

1) On shaft sizes greater or equal to 2.5 inches, provide a split face seal.
2) On shaft sizes less than 2.5 inches, provide a cartridge single seal.

2. Provide the following environmental controls.

a. On vertical pumps, provide Plan 13.

2.4 **FINISHES**. In accordance with Section 43 21 00, "Pumps, General. Manufacturer may use manufacturers standard paints finishes, but shall comply with requirements for coating thickness and materials. All shop coats of primed surfaces shall be compatible with field finish paint specified in Section 09 90 00 – Painting.

2.5 **SOURCE QUALITY CONTROL**. Shop tests in accordance with Section 43 21 00, "Pumps, General." With respect to vertical turbine pumps, a non-witness bowl performance test with calibrated lab motor is required.

PART 3 - EXECUTION

3.1 **GENERAL**. In accordance with Section 43 21 00, "Pumps, General."

3.2 **FIELD QUALITY CONTROL**. Perform manufacturer's field service and start-up for each pump.

A. Contractor shall provide services of certified pump specialist to measure, adjust, and certify that each pump and motor are aligned properly, and that the alignment is set within the allowable tolerances for the pump and motor per the pump manufacturers recommended limits and the requirements specified in Section 43 21 00, "Pumps, General."

3.3 **CLOSEOUT ACTIVITIES**

A. **Perform a 30-day operational demonstration** of the pumps.

B. **Provide a total of 4 hours of training** that can be divided into as many as two different sessions on two different days as directed by the Owner.

3.4 ATTACHMENTS

A. Equipment Schedule

Backwash Water Pump	
Quantity	1
Location	High Service Pump Room Clearwell No. 2
Minimum solid size diameter (in)	N/A
Minimum piping connection size (in)	18
Liquid being pumped	Finished Water
NEC Area Classification (Explosion proof, unclassified)	Unclassified
Percent solids in liquid (%)	<1.0
Environment (Exposed, Submerged, Outdoors, etc)	Indoors
Maximum operating speed (rpm)	1,180
Maximum Motor Horsepower (Hp)	125
Motor Voltage (volts)	460
Phase (single or three)	Three
Duty (variable or constant Speed)	Variable
Elevations	
Maximum Water Level (ft)	969.50
Minimum Water Level (ft)	957.00
Pump Discharge Centerline (ft)	973.67
Bottom of Strainer, minimum (ft)	947.83
Pipe Centerline at Filters (ft)	973.50
Primary Design Point	
Capacity (gpm)	5,000
Head (ft)	32
Maximum NPSHr (ft)	11
Minimum Efficiency (%)	75
Secondary Design Point	
Capacity (gpm)	4,000
Head (ft)	28
Tertiary Design Point	
Capacity (gpm)	2,500
Head (ft)	23

Conditions are defined in paragraph 2.1 C.3 of Section 43 21 00, "Pumps, General."

END OF SECTION

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SECTION 44 43 50.03

FILTER EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF THE WORK

A. **Scope of Work**. The Contractor shall provide all labor, material, and equipment required to furnish and install the filter equipment in six (6) dual bay 15.33 ft. x 20 ft. (306.6 sf) filters complete and as shown on the drawings and as specified herein. The filter equipment shall consist of gravel support, filter media, air scour systems, all fasteners, supports, and appurtenances. Filter control consoles shall be furnished by the system integrator under Division 40. The scope of work shall also include cleaning and refurbishing the existing wash water troughs and leveling of the weir plates after the filter media replacement is complete.

B. **General Requirements**

1. The existing filter media, including the anthracite media sand and gravel shall be removed by use of hydraulic eductor to a hold tank for collection of removed media. The recovered media shall be disposed of at an approved waste disposal site.

2. The Leopold clay filter block type underdrain system shall be inspected and cleaned by a high-pressure wash in each of the twelve filter compartments including re-drilling of the underdrain holes.

3. The existing filter underdrain system of ceramic tile blocks shall be re-used. The Owner shall inspect the tile and joints for the repair and/or replacement as shown on Contract Drawings and as needed. The manufacturer shall furnish 300 24-inch clay tile underdrain blocks.

4. Damaged underdrain tiles shall be repaired or replaced prior to placement of the filter media. Joints shall be repaired as needed. Repairs shall be made on a time and material basis. Damages to underdrains caused by the Contractor shall be replaced and performed at no cost to the Owner.

5. Grout shall be one (1) part Portland cement and two (2) parts silica sand.

6. Repair and/or replacement work shall be done in strict accordance with manufacturer’s recommendations and instructions. A seven-day curing period shall be provided on all repairs.

7. The new filter replacement gravel, torpedo sand, and anthracite filter media shall be furnished and installed per manufacturer’s recommendations for handling, placement, washing, and disinfection of media.

8. The existing wash water troughs shall be pressure washed and rehabilitated in place, without the requirement for removal, as described in the contract plans and specifications.

9. The existing support brackets used to support surface wash water piping and rotating arm mechanisms shall be removed from each filter.

10. A new air scour wash water system shall be installed in each filter and shall include new piping, drops, air scour grid, supports, brackets and fasteners as shown on the plans or as recommended by the manufacturer.

C. **The drawings and specifications** direct attention to certain features of the equipment, but they are not intended to cover all details of the equipment and systems. The Contractor shall provide a fully operational and complete system.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**

1. Codes. Perform all work to furnish and install the filter equipment in compliance with applicable requirements of governing agencies.

2. Standards.

a. NEMA - National Electrical Manufacturers Association.

b. ANSI - American National Standards Institute.

c. NIOSH - National Institute for Occupational Safety and Health.

d. AWWA - American Water Works Association.

1) B100 - Filtering material.

2) C653 - Disinfection of water treatment plants.

3) F101 - Contact, molded, fiberglass, reinforced plastic washwater troughs and launders.

4) F102 - Matched, die-molded, fiberglass, reinforced plastic weir plates, scum baffles and mounting brackets.

e. NSF – Standard 60 and 61 – Drinking Water Systems Components – Health Effects.

f. ASTM – Standards listed in Section 1.4.H, Table 1.

B. **Quality**. All equipment shall be installed in accordance with manufacturer's instructions and recommendations. Fabrication and installation shall be in accordance with conforming shop drawings.

1.4 SUBMITTALS

A. **Approval Drawings**. Shop drawings shall be submitted according to Division 01 and shall include:

1. Manufacturer's name and model numbers.

2. Manufacturer's standard product data.

3. Equipment specifications.

4. Materials of construction

5. Repair parts.

6. Dimensional layouts and required clearances.

7. Weights.

8. Anchor bolts.

9. Bill of material.

10. Complete description of sufficient detail to permit an item comparison with the specifications.

11. Performance characteristics.

B. **Operations and Maintenance Manuals**. Operation and Maintenance (O&M) manuals shall be submitted to the Engineer prior to delivery of the equipment.

C. **Samples/Material Certification of Filter Media**

1. Submit a laboratory analysis of each proposed filter component including the effective size and uniformity coefficient.

2. Submit an Affidavit of Compliance stating that the filter material proposed to be furnished will comply with all applicable provisions of AWWA B100.

3. Contractor shall submit representative samples to the Engineer and Ohio Environmental Protection Agency (EPA) for analysis and approval prior to shipment to the site. The sample shall be sent immediately after shop drawing approval.

a. Media Sample: 1-Liter dry sample of each media type placed in tightly closed clear plastic jars and labeled appropriately.

D. **Operator Training Information**. Operator training data shall be submitted with the O&M manuals.

E. **Personnel Qualifications**. Qualifications statements of all manufacturers' representatives that will be servicing the equipment or conducting the operator training sessions shall be submitted with the O&M manuals.

F. **Installation Plan and Schedule**. Prior to initiation of any work on the filters, the Contractor shall submit a detailed plan indicating intended methods and procedures for all phases of the filter rehabilitation that includes shutdown and start-up phases for each filter. This plan shall include a detailed proposed schedule for this portion of the work. No work on the filters shall be initiated until this plan is approved. All shutdowns and start-ups shall be coordinated with the Owner.

A. The manufacturer shall furnish a Certificate of Installation stating that the filtering materials were installed, backwashed, and skimmed under the direct supervision of a trained and qualified technician, and in accordance with AWWA B100-01 and as specified herein

1.5 JOB CONDITIONS

A. **Coordination with Other Work**. The Contractor shall coordinate the scheduling of the work including demolition and concrete repair and painting activities, and the location of equipment, piping, and conduit to prevent interferences and delays.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. The delivery, storage, and handling of the filter equipment shall be in accordance with the manufacturer's instructions.

B. **Delivery**

1. All equipment shall be delivered in an undamaged condition.

2. Media. Shipment shall be made in bags or semi-bulk containers.

a. Bags. Shipment may be made in suitable heavy-duty cloth, paper, or plastic bags containing not more than one cubic foot of material. Each bag shall be marked in an appropriate manner so that its contents are identified. The following information shall be included in the marking: gradation, date of filling, and lot or stockpile identification.

b. Semibulk Containers. Shipment may be made in suitable heavy duty, woven semibulk containers, each containing one or more tons of material. Semibulk containers shall have attached straps or sleeves strong enough to support their entire weight when full to aid in handling. Each semibulk container shall be marked so that its contents are identified, including gradation, date of filling, and lot or stockpile identification.

C. **Storage**

1. Contractor shall make all arrangements and provisions necessary for the storage of the filter equipment in accordance with the manufacturer's instructions.

2. Storage and Handling of Materials. Filter materials shall be kept clean. Materials shipped in bags or semibulk containers shall be covered with a durable opaque material to block sunlight and to provide protection from weather. Bags and semibulk containers shall be stored on pallets or dunnage. Each size and type of filter material shall be stored separately. When materials are shipped in bags or semibulk containers, under no circumstances shall material be removed from the bags or the semibulk containers prior to placement in the filter, except for sampling.

D. **Handling**

1. Provide the equipment and personnel necessary to handle the filter equipment by appropriate methods to prevent damage to the delivered equipment and other stored materials or adjacent structures or equipment.

2. The filter equipment shall be at all times handled in a safe manner and as recommended by the manufacturer.

1.7 **SPECIAL WARRANTY** (Not Used)

PART 2 PRODUCTS

2.1 **GRAVEL SUPPORT**. Gravel support will be used in this project. The gravel media support shall be provided over the existing clay filter block underdrain system and shall provide adequate support of the filter media. Gravel shall be cleaned and washed and be hard, durable, rounded silica particles and not include flat or elongated particles. Gravel

shall be placed a minimum of 9-inches thick per the following schedule (from bottom to top):

Gravel Size	Gravel Layer Thickness
3/4” to 1/2" (bottom)	3”
1/2” to1/4”	3”
1/4” to 1/8” (top)	3”

2.2 FILTER MEDIA

A. **General.** The Contractor shall provide all filter media for the six (6) dual bay filters. The filter anthracite and its installation shall be in accordance with AWWA B100-01. The filter media shall be placed over the underdrain system in uniform, level layers of the depth and gradation as stated herein. Acid solubility tests are required. The materials shall be obtained from sources regularly engaged in producing and furnishing the specified materials. The Engineer and the Ohio EPA shall be provided with samples, and the samples shall be approved prior to shipment. The Contractor shall provide an affidavit with the samples stating that the materials furnished comply with the applicable requirements of AWWA B100-01 and be NSF 61 listed.

1. All filter media shall be installed in accordance with instructions from the manufacturer, under the direct supervision of a technician provided by the manufacturer, and in the presence of the Owner or the Engineer. Workmen shall not stand or walk directly upon the media, but on boards which will sustain the weight of the workmen without displacing the filtering materials. For the media, an additional amount shall be initially provided and placed as required so that after washing and scraping, the surface will be as near as possible to the finished elevation. Upon completion, the depth of the materials shall be the depth specified. The manufacturer shall furnish a Certificate of Installation stating that the filtering materials were installed, backwashed, and skimmed under the direct supervision of a trained and qualified technician, and in accordance with AWWA B100-01 and as specified herein.

B. **Filter Anthracite.** Filter anthracite shall be provided to a finished depth of 30-inches. Anthracite shall be installed in two (2) 15-inch lifts, backwashing and skimming after each lift is installed, with at least 1 additional inch to be provided and scraped off after washing. Filter anthracite shall consist of hard, durable coal particles of various sizes, and shall be visually free of clay, shale, and extraneous dirt. Acid solubility shall not exceed 5 percent. The anthracite shall have a Moh’s scale of hardness greater than 2.7. The specific gravity shall be greater than 1.45. Filter anthracite shall have an effective size of 0.60 to 0.80 mm, and a uniformity coefficient less than 1.40. After placement of the anthracite, the filter shall be washed at least three successive times, with the surface to be scraped after each washing. After washing, the surface shall be placed at the finished elevation, with additional material added as necessary to bring the surface to the finished elevation.

C. **Torpedo Sand.** The intermediate layer of torpedo sand shall be placed above the gravel. The quality and specific gravity shall be as specified for gravel. The particles shall have an effective size of 0.80 to 2.0 millimeters (mm) and a

uniformity coefficient not greater than 1.7. The finished bed depth, after backwashing and skimming of fines and debris, shall be 3 inches.

2.3 WASH-WATER TROUGH – REHABILITATION

A. **General**. The existing fiberglass wash-water troughs shall be cleaned and rehabilitated. Rehabilitation shall include filling hairline cracks, small holes, and other blemishes with new fiberglass reinforced polyester resin. The interior and exterior surface of the rehabilitated trough shall be smooth with a glass surfacing mat. The existing rehabilitated troughs shall be mounted using new mounting brackets and hardware. The rehabilitation of the existing troughs shall meet the requirements of ANSI/AWWA F101.

2.4 AIR SCOUR SYSTEMS

A. **General.** Provide under this section to furnish twelve (12) air grid assemblies installed in each filter. There air scour system can install the system embedded in the media or as a drop-in type system. The drop-in system shall meet all Ohio EPA short circuiting requirements and can be designed to be removed for maintenance. The responsibility of the air scour manufacturer is at the first flanged connection of the air supply line within each filter; Contractor is responsible thereafter as shown on Contract Drawings.

1. **Embedded Type**. Provide and install twelve (12) Air Grid Assemblies, manufactured from type 304 stainless steel, schedule 5 pipe. Each assembly shall consist of a 4-inch diameter air manifold pipe that will run the width of the filter cells and commence with a flange connection inside the filter. The air manifold pipe will connect to the lateral pipes located above the filter torpedo sand. The air distribution header will have threaded tee's and require the lateral pipes to be field assembled by the contractor. Individual components of the modules and support hardware shall be fabricated of Type 304 stainless steel. Any pipes that penetrate the filtering media shall be double-wall, Schedule 40, Type 304 stainless steel.

   a. **Accessories.** Any double walled piping penetrating the filtering media shall be provided with a means to install an interstitial pressure sensor. The pressure sensor(s) shall be provided by the air scour system manufacturer and meet the requirements of gauge pressure transmitters as specified in PART 2.4.A.3 of this specification section. The annulus space shall be pressurized to 60 psi. If the pressure in the annulus space drops by more than 10 psi, the sensor shall signal an alarm.

   b. **Manufacturers.** F.B. Leopold, Siemens, Roberts or approved equal.

2. **Drop-in Type.** Furnish the air supply piping for the within each of twelve filter basins. Air supply piping shall be fabricated of Schedule 10, Type 304 stainless steel. Sufficient quantities of grid modules and support hardware shall be furnished for each filter to provide full coverage of the filter area. Individual components of the modules and support hardware shall be fabricated of Type 304 stainless steel. The drop-in units shall be designed to accommodate installation and removal by immersing in a fluidized bed without the need for lower support and securement hardware for modules. Drop pipes shall be furnished for

connecting the modules to the air supply piping. Drop pipes that penetrate the filtering media shall be double-wall, Schedule 5 (Typ 304) for outer and Schedule 40 (Type 304) inner.

a. **Accessories.** Any double walled piping penetrating the filtering media shall be provided with a means to install an interstitial pressure sensor The pressure sensor(s) shall be provided by the air scour system manufacturer and meet the requirements of gauge pressure transmitters as specified in PART 2.4.A.3 of this specification section. The annulus space shall be pressurized to 60 psi. If the pressure in the annulus space drops by more than 10 psi, the sensor shall signal an alarm.

b. **Manufacturers.** Roberts Filter, or approved equal.

3. Pressure Switch. The equipment manufacturer shall furnish with the process equipment, a high-pressure protector. The control shall utilize a pressure sensor/isolator to separate the process air from the pressure sensing instrumentation. The process air pressure shall be transmitted by liquid silicone oil sealed between carbon steel housing and a flexible elastomer element. The pressure sensor elastomer element shall have integrally molded flange face gaskets and lip seals. The pressure sensor shall be compatible with 150 lb. (300 lb.) ANSI flanges. Conduit, wire, and installation of same shall be by Division 26. See Electrical Control Diagrams for switch operation and additional information.

B. **Design Basis.** The air scour system shall be capable of operating under design air flow of 2.5 scfm/sf to the filter. The air scour system shall provide a uniform diffused air pattern to provide supplemental agitation of the media bed during washing.

C. **Diffusers.** Diffusers shall be manufactured and installed per the air scour grid system manufacturer's recommendation. Systems utilizing "slotted" diffusers shall not be allowed. Diffuser opening must contain a method of not allowing media penetration, such as a screened opening.

D. Included with the air grid system are the required type 304 stainless steel supports to attach the distribution headers to the filter walls.

2.5 FILTER CONTROL SYSTEM

B. Filter Control Console. Furnished under Division 40.

C. Field Instrumentation

1. Differential pressure (loss of head) sensors and transmitters are furnished under Division 40.

2. Level sensors and transmitters are furnished under Division 40.

3. The system shall include new effluent turbidity meters provided for each filter under Division 40.

4. Interstitial pressure sensors/transmitters are specified under Division 40.

2.6 FASTENERS

A. **All threaded and flanged fasteners**, mounting brackets and hardware shall be corrosion resistant Type 18-8 stainless steel of adequate composition and section for the service intended.

2.7 **SUPPORTS**

A. **All supports shall be** of corrosion resistant Type 304 stainless steel construction.

2.8 **DESIGN PARAMETERS**

Number of Filters	6 dual bays
Filtering Capacity	17.7 mgd (1 filters out of service) 21.2 mgd (all filters in service)
Design Filter Rate	3.0 gal/min/ft^2
Dimensions of Filters	15.33’x20’x30” (306.6 sf.) each
Elevations	
Existing Filter Slab	972.75
Top of Clay Tile	973.63
Top of Media	977.13
Top of Wash Water Trough	980.00
Top of Wall (Filter Room Floor)	984.00
Backwash Design	
Underdrain System	Leopold type clay filter block
Media Support	Gravel
Number of Washwater Troughs	3 per filter
Backwash Water Rate	8 – 20 gal/min/ft^2
Backwash Duration	18 min., average
Air Scour	
Grid size (filter dual bay)	767 scfm per filter
Grid and diffuser piping	Type 304L Stainless Steel, Sch. 10S/40S
Air scour flow rate	2.5 scfm/sf
Leak Detection Pressure Switch	Double wall drop pipe with 1 per drop

2.9 **MANUFACTURER**

B. **General.** All components of the filter media, clay tiles, and air scour equipment shall be supplied by one manufacturer. The manufacturer shall be Roberts Filter Manufacturing Company.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. **Method**.

1. Install equipment in accordance with conforming shop drawings, manufacturer's installation instructions, and as shown on the drawings and as specified herein.

2. Before any work is performed inside the filters, the clearwell storage tank shall be isolated from the filter to eliminate the risk of contamination. Clearwell isolation methods shall be coordinated with both the Owner and the Engineer.

3. All filter operation shall be by the Owner. Coordinate the scheduling and work of filter rehabilitation with the Owner to minimize any potential disruption in normal plant operations.

4. Protection of Equipment. The contractor shall take means to protect filter equipment such as wash water troughs, underdrain system etc. Any filter equipment or other water plant equipment damaged during and due to work related to filter rehabilitation, shall be repaired or replaced at the Contractor's expense at no additional cost to the Owner.

5. Media Disposal. The materials removed as a result of the contract shall be disposed of off site at an approved landfill, unless directed otherwise. The contractor shall include all the costs for equipment rentals to remove the filter media, handling, hauling and disposal. This shall be included in the scope of bids.

B. **Preliminary Demolition and Cleaning Activities**

1. The Contractor shall start filter rehabilitation in accordance with the approved sequence of construction. The contractor shall only take a maximum of one (1) dual cell filter out of service at a single time.

2. All media and gravel shall be removed from the filters

3. Side walls of the filter boxes from elevation 1065.00 to 1075.00 shall be pressure washed to remove deposits and crusts.

4. Filter walls shall be observed to determine the need for concrete repair to cracks or spalling concrete in filter box walls that are present below the water line and in need of repairs per Division 03 for concrete repairs and epoxy injection in cracks and painted per Specification Section 09 90 00. Any repairs will be paid under the Concrete Repair Bid Allowance.

5. All concrete repairs to the filter walls, beams, walks, and floors shall be completed prior to cleaning the filter bottom and all necessary measures to collect debris and protect the filter during the concrete repairs to cracks and spalling will be completed.

6. The original in-place clay block underdrain shall be cleaned with a high-pressure wash after the filter media is removed, the walls cleaned, and the area under the underdrain system are cleaned. Any media or other debris will be removed from this area. Once sufficiently cleaned, the block shall be observed by the Contractor, Engineer and Owner. Contractor shall drill out all accessible holes in the underdrain to re-establish original hole diameter of 5/16-inch in the top of the block (up to 48 holes per square foot).

    a. Damaged Underdrains. Damaged clay underdrains shall be replaced under the Filter Repair Bid Allowance. Tile damaged by contractor negligence will be replaced at the contractor's expense at no additional cost to the Owner. The City may have a limited number of underdrain sections available. However, if the Owner does not have additional spares and new sections of underdrains are necessary to be purchased, the Contractor shall plan accordingly since only one (1) manufacturer makes the required underdrains in single run per year.

C. **Filter Media Installation**

1. Requirements

a. The Contractor will not be permitted to pile the existing or new filter media on the floors of the Water Treatment Plant and shall protect the floors by covering them with plastic sheeting and plywood or otherwise to the satisfaction of the Owner when moving or using equipment.

b. Measures shall be taken to contain dust within the area of the filter being worked on by erecting a temporary enclosure of wood framing and plastic sheeting or otherwise to the satisfaction of the Owner.

c. Plastic sheeting shall be minimum 6 mil thick polyethylene film. Floor protection and dust containment measures shall be approved by the Owner prior to the work.

d. Measures shall be taken to protect all guardrail, handrail, windows, electrical gear, and other equipment and facilities in the area of the work.

e. Damage to existing facilities resulting from the Contractor's operations shall be repaired or replacements made to the satisfaction of the Owner by and at no additional expense to the Owner.

2. Preparation

a. All filter media removed shall be disposed of by the Contractor off the project site within two (2) working days after removal.

a. The Contractor is responsible for any and all permits required for disposal of the filter media, including testing that may be necessary for determining whether the media should be handled as hazardous waste.

b. The filter media shall be removed using a vacuum or pump. However, the condition of some of the layers of filter media can be best described as a clumpy, dense, granular mass, and it is unlikely that conventional removal methods, such as vacuuming and pumping, will be suitable for removal of all media. The Contractor should assume hand tools will be necessary for the removal of some of the media.

c. Upon the completion of removals, the surfaces of the filter walls and the filter underdrain shall be cleaned of all gravel, calcium, and other deposits using power wash or other means necessary.

d. The Contractor shall coat the walls per Specification Section 09 90 00.

e. The fiberglass wash water troughs shall be cleaned of all calcium and other deposits using pressure wash or other means necessary. Any damage to these components as a result of cleaning and/or handling operations shall be repaired or replaced to the satisfaction of the Owner. New supports shall be installed and following these activities, the weirs shall be leveled.

f. Before any materials are placed, the top elevation of the media layer shall be marked by a level line on the inside of the filter.

g. Each cell shall be kept clean throughout placement operations.

h. No filter media shall be placed until the filters are inspected and approved by the Engineer.

3. Placement

a. The installation of the new media shall be in accordance with Section 4.4 of AWWA B100-01. The three layers of media in the new filters include Gravel Base, Torpedo Sand, and Anthracite. Filter anthracite shall be installed using the “wet method” using a portable eductor unit and hopper to mix the media with water before pumping it into the filters.

b. Caution in Installing Material. The bottom layer of media shall be placed carefully to avoid damage to the filter underdrain system. Workers shall not stand or walk directly on the filter material. They shall walk on board or plywood that will sustain their weight without displacing the material.

c. Placement of Layers. Each layer shall be completed before the layer above is started. The filter material shall be deposited in a uniform thickness, with the top surface screeded and brought to a true level plane. Care shall be exercised in placing each layer to avoid disturbing the surface of the layer beneath.

4. Washing.

a. The installation of the new media shall be in accordance with Section 4.4 of AWWA B100-01.

b. Initial Wash of Each Layer. After each layer of the filter media has been placed, washwater shall be admitted slowly upward through the underdrain system until the entire bed is flooded. The bed shall be allowed to stand for as long a period as the Engineer deems necessary to saturate the media before initial wash, provided this period shall not be less than 12 hours if the bed has been allowed to stand dry. The wash rate shall be increased gradually during the initial wash to remove air from the bed. This process shall be completed for each layer of media prior to placement of the next layer as specified herein. The three layers of media in the new filters include Gravel Base, Torpedo Sand, and Anthracite.

c. Backwash. The required number of backwash cycles shall be determined by the Engineer. A minimum of three cycles shall be performed, and then all fine particles shall be removed by skimming. During each backwash, the water shall be applied at an initial rate of not more than 2 gallons per minute per square foot (gpm/sf) of filter area. The backwash rate shall then be increased gradually over a period of 4 minutes to 17 gpm/sf and maintained at the maximum rate for not less than 5 minutes.

5. Skimming. After the initial wash, the filter shall be partially drained and a layer of fine material approximately 3/16-inch-thick shall be removed from the surface of the filter by skimming.

6. Disinfection.

a. Disinfection of the filters shall be in accordance with AWWA C653-03. After all other work is completed, and before a filter is placed in service, the filter and associated gullet spaces shall be disinfected by chlorination. This can be accomplished by injecting sufficient chlorine into the wash water to produce a chlorine concentration of at least 25 milligrams per liter (mg/l) throughout the filter and letting the chlorinated water stand for at least 12 hours. After the 12-hour period, if the chlorine residual is less than 15 mg/l, the filter shall be backwashed or run to waste, and the procedure shall be repeated. Sufficient tests should be made at the top and bottom of the filter unit to ensure that the residual readings measure the lowest chlorine level in the filter unit at the end of the 12-hour period.

b. At such time as the chlorine residual is 15 mg/l or greater, the filter shall be backwashed or run to waste and filled with potable water, and a sample shall be taken off the filter effluent and a total coliform test performed. If the total coliform count is greater than one, the entire disinfection procedure shall be repeated, until two consecutive samples are satisfactory. Consecutive samples shall mean that a sample is taken and the test results obtained before the next sample is taken.

c. Disinfection shall continue at the expense of the Contractor until acceptable results are obtained at no additional cost to the Owner.

d. The Owner will perform all tests for chlorine residual and total coliform.

e. The Contractor shall consult the Engineer prior to disinfection for estimating the amount of chlorine to add to each filter so as not to over-chlorinate.

f. Other means of disinfection may be used when approved by the Owner, the Engineer, and the Ohio EPA.

g. Chlorine residual of water being disposed shall be neutralized before discharging to the sanitary sewer system by treating with a chemical listed in Appendix A of AWWA C653-03. The Contractor shall consult the Engineer prior to dechlorination for estimating the amount of chemical agent to be added to each filter.

7. Preparing the Filter for Service.

a. The filter shall be prepared for service in accordance with Section 4.5 of AWWA B100-01.

D. **Wash-Water Troughs**

1. Wash water troughs will be cleaned with a high-pressure wash, prior to the installation of the air scour system.

2. The weirs shall be leveled to the elevation noted on the Contract Drawings. Weir edges shall be level, straight, and with not more than

1/8-inch variation from level throughout the entire length when repositioned.

E. **Air Scour**

1. Air Scour system shall be installed in accordance with the manufacturer's instructions and in the on-site presence of a factory trained installation technician. All fasteners shall be 316 Stainless steel.

F. **Interface with Other Items**

1. Complete all electrical power and control connections under Division 26, "Electrical."
2. Complete all piping connections under Division 40, "Process Integration"
3. Coordinate the work of the filter control system with the backwash pump, existing filter-to-waste pump, and pressure sensor (air scour) systems as well as with the existing turbidity meters.
4. Coordinate with Section 40 95 33, Supervisory Control and Data Acquisition System (SCADA).

3.2 FIELD QUALITY CONTROL

A. **Inspection**. It is the Contractor's responsibility to notify and coordinate with the equipment manufacturer in a timely manner in order for them to instruct the Contractor on the installation of the media and equipment, conduct their required inspection, testing, and instruction as required by this specification section. A representative of the manufacturer shall be onsite for testing of each filter. This will be six (6) trips for a total of twelve (12) days.

B. **Field Tests**. Appropriate testing procedures shall be proposed by the Contractor for review by the Engineer. The Engineer shall be notified and afforded the opportunity to witness the testing procedures. All testing materials and equipment required shall be furnished at no additional cost to the Owner.

1. Dry Test. Dry testing shall include:
    a. Media. Each filter material layer shall receive a level test before proceeding with placement of the next layer.
2. Wet Testing. Wet testing shall include:
    a. Flow Testing. Each filter shall be tested over the full operating range for filter rate, washwater rate, and surface wash rate to demonstrate compliance with the operating conditions specified in the Design Parameter section.
    b. Washwater Troughs. Washwater trough weirs shall be tested for conformance with level requirements herein.
    c. Air Scour. Air scour system shall be tested for media agitation and full filter area aeration coverage over the full range of operation specified in the Design Parameter section.

3.3 PROTECTION

A. **Requirements**. The Contractor shall be responsible for provision to protect the filter equipment and associated equipment after installation but prior to

acceptance by Owner. The Contractor shall remove all protective means installed at completion at acceptance of the project.

3.4 ADJUSTING

A. **Test Results**. If the results of the field tests do not show successful operation of the filter equipment, the Contractor shall repair, adjust, modify, or replace the equipment in accordance with the manufacturer's instructions until the equipment and systems are operating as required and the tests are successfully completed. This shall be done at no additional cost to the Owner.

END OF SECTION

SECTION 46 31 11

CHLORINE GAS FEED EQUIPMENT

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK.** Provide the labor, tools, equipment, and materials necessary to furnish and install the chlorination equipment in accordance with the plans and as specified herein.

1.3 **QUALITY ASSURANCE**

A. **Codes**. Perform all work to furnish and install the chlorination equipment in compliance with applicable requirements of governing agencies having jurisdiction.

B. **Standards**

1. AISI – American Iron and Steel Institute
2. ANSI – American National Standards Institute.
3. ASTM – American Society for Testing and Materials.
4. AWS – American Welding Society.
5. CI – Chlorine Institute.
6. NEMA – National Electrical Manufacturers association.
7. NIOSH – National Institute for Occupational Safety and Health.
8. UL – Underwriters' Laboratories, Inc.

C. **Regulatory Agencies.** Perform all work in compliance with the requirements of the following regulatory agencies:

1. OEPA – Ohio Environmental Protection Agency.
2. OSHA – Occupational Safety and Health Administration.

D. Installation List. Manufacturer of components listed herein shall show successful installation of their equipment, of similar size and purpose. Provide information of five (5) installations each, including name of facility, purpose, size, contact name, organization, and telephone number.

1. Contractor is responsible for installing the water supply to the chlorinators, distribution panels, and main connections.

1.4 **SUBMITTALS**

A. **Product Data.** Submit manufacturer's product data in accordance with Section 01 33 00.

B. **Approval Drawings**. Submit shop drawings and product data for approval. Shop drawings shall be in accordance with Section 01 33 00 and shall include:

1. Complete description in sufficient detail to permit an item-by-item comparison with the specifications.
2. Manufacturer's name and model numbers.
3. Installation list.
4. Manufacturer's standard product data.
5. Schematics.
6. Equipment specifications.
7. Materials of construction.
8. Repair parts.
9. Dimensional layouts including sectional view and required clearances.
10. Weights.
11. Anchor bolts for proposed equipment shall be provided by the Contractor.
12. Bill of material.
13. Instrumentation and schematics.
14. Power/utility requirements.
15. Manufacturer's instructions for installation and operation.
16. Warranty information.

C. **Operation and Maintenance (O&M) Manuals**. Submit O&M manuals in accordance with Section 01 33 00 of these specifications. Submit the initial review copy of the O&M manual and six revised copies prior to delivery of the equipment.

D. **Operator Training Information**. Submit operator training data, in accordance with Section 01 79 00, and operator training lesson plans, in accordance with Section 01 33 00, with the six revised copies of the O&M manual.

E. **Personnel Qualifications**. Submit qualification statements, in accordance with Section 01 33 00, of all manufacturer's representative personnel that will be servicing the equipment or conducting the operator training sessions with the six revised copies of the O&M manuals.

F. **Manufacturer's Representative Reports**. Submit manufacturer's representative reports, in accordance with Section 01 75 00, within 48 hours of each site visit. Include product and material certifications and inspection data as specified in Section 01 33 00 with this report(s).

G. **Site Test Reports**. Submit a test report in accordance with Section 01 75 16 within 48 hours of completion, suspension, or termination of testing.

H. **Submit warranty and special warranty** as specified in Contract Documents.

I. **Field Testing Reports**

1. Manufacturer's Representative Reports. Manufacturer's representative reports summarizing all field work, including adjusting, dry testing, and wet testing of the equipment in accordance with Section 01 33 00 and the requirements of this specification section. Include product and material certifications and inspection data as specified in Section 01 33 00, with this report(s).
2. Dry Test Report. Dry test report shall be in accordance with Section 01 33 00 and the requirements of this specification section.
3. Wet Test Report. Wet test report shall be in accordance with Section 01 33 00 and the requirements of this specification section.

1.5 **JOB CONDITIONS**

A. **Coordination with Other Work**. Coordinate the scheduling of the work and the location of equipment, piping, and conduit to prevent interferences and delays.

B. **Chlorine Gas Cylinders**. The chlorine gas 1-ton cylinders will be supplied by the Owner.

C. **Supplier**. All chlorination equipment specified herein shall be furnished by a single supplier.

1.6 **DELIVERY, STORAGE, AND HANDLING.** Deliver, store, and handle the chlorination equipment in accordance with Section 01 60 00 and the manufacturer's instructions.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **VACUUM SUPPLY EQUIPMENT**

A. Vacuum Regulators

1. Each of the two (2) on-line chlorine ton cylinders shall have a vacuum regulator-check unit with an automatic switchover option included with cast iron yokes. The unit shall be U.S. Filter/Wallace & Tiernan Products 510S, or equal.
2. It shall be a vacuum-operated, sonically regulated type system consisting of a vacuum regulator and flowmeter with rate valve. It shall have a maximum capacity of 500 pounds per day chlorine and sized to feed 500 pounds per day. It shall be manually controlled having a feed range of 20:1 and the capability to control within ±4 percent of the indicated feed rate.
3. The ton container mounted vacuum regulator shall consist of a vacuum regulator designed to reduce full supply pressure to a vacuum without venting. A self-aligning yoke shall be provided as an integral part of the vacuum regulator. The unit shall include a selector knob and icons to indicate the chlorine gas container status. An off position shall be

provided to isolate the diaphragm and internal components from atmospheric air when the operator changes containers. It shall contain internal pressure relief. The 500-pound-per-day unit shall include a secondary check to prevent gas under pressure from venting into the atmosphere. The check valve shall close in the event of leakage past the primary valve.

4. The unit shall contain a display with removable filter and 110-volt heater for mounting on a ton container.

2.2 CHLORINE GAS FEEDERS

A. **Type.** Chlorine gas feeders shall be of the floor mounted, vacuum operated, solution feed type. Each feeder shall consist of a control unit, vacuum regulator, pressure relief valve, and injector as specified herein. All parts of the system shall be easily accessible, and materials of construction shall be especially adapted to the handling of, and resistance to, the action of chlorine gas.

B. **Manual Control Unit.** Manual control units shall be provided with the feed capacity as listed in the equipment schedule. Control unit shall include a manually adjustable V-notch orifice, vacuum relief valve, differential regulating valve, and rotameters. Rotameters shall have a 10-inch scale. The feed range shall be 20:1 with a V-notch control system capable of maintaining the set feed rate to within 4 percent of the indicated flow.

C. **Vacuum Regulator.** Provide two (2) 1-ton cylinder-mounted vacuum regulating valves as specified herein.

D. **Injectors.** Provide two (2) 1-inch standard fixed throat injectors that shall be furnished and panel mounted with the control units. The throat and tail pieces for the injectors shall be selected to deliver the maximum feed capacity as listed in the equipment schedule with a water supply pressure of 75 pounds per square inch (psi) and 150 psi, as shown on contract drawings. Injectors shall be supplied with a combination anti-siphon injector and diaphragm check valve and a positive suction shutoff. Under no condition of operation shall it be possible either for water to get into the gas inlet or for gas to get into the water inlet.

E. **Control Unit Capacity Conversion Kit.** Provide all parts necessary, including glass rotameters, V-notch plug, and differential seat to convert each control unit's feed rate capacity to the values listed in the equipment schedule.

F. **Spare Parts.** Provide a spare rotameter, spare plug, differential seat for V10k and V2005, and injector for each chlorinator.

G. **Manufacturers.** Gas feeders shall be manufactured by Wallace and Tiernan or equal.

H. Equipment Schedule.

Control Type	Gas	No. of Units	Max Feed Capacity	Design Feed Capacity	Maximum Feed Rate	Water Requirement
Manual	Chlorine	2	500 lb/Day	207 lb/Day	2.4 mg/l at 15.9 MGD	25 GPM at 80 PSI

2.3 PIPE AND VALVES

A. The requirements listed under this section shall apply for the section of piping between the chlorine containers in the Container Room to the chlorinator in the Chlorinator Room. Contractor shall be responsible for the pipeline and accessories and Chlorinator Manufacturer shall provide associated gauges and accessories that come standard with their equipment.

1. Pipe
   a. **Exposed Service.** Shall be Schedule 80 seamless Steel per ASTM A106. Lining is not required. Coating shall be HPIC per Specification 09 90 00 and fittings be 3,000 LB forged carbon steel that are screwed or socket welded. Joints shall be screwed or socked welded with 1,500 LB flanges at equipment and valves.
   b. **Buried Service.** Shall be Schedule 80 black seamless steel per ASTM A106. Lining is not required. Coating shall be bituminous with welded joints with 3,000 LB forged carbon steel fittings.
2. Valves
   a. Isolation valves shall be ball type. The body shall be of carbon steel with reinforced TFE seat. Ball and stem shall be Monel with top entry type construction.

2.4 ACCESSORIES

A. **Solution Distribution Panel.** Provide a two (2) separate proportioning distributor panel complete with manifold valves, varea-meters, shutoff valves, and throttling valves, all mounted on a common wall mounted panel rated for 150 PSI and 75 PSI per Contract Documents.. Valves shall be 1-1/4-inch ball type for isolation and throttling. Piping and fittings shall be schedule 80 PVC pipe. Distribution panel shall be Wallace & Tiernan, or equal and be fabricated sheet-steel with enamel finish to match the existing distribution panels.

1. The distribution panel shall include 1-1/4 manifold piping with two (2) ball valves two (2) for each feed point stream and one (1) ball valve between feed point streams as shown on Contract Drawings. The rotometers shall be 1-inch diameter, 10-inch long glass tube verea-meters with flow rates from 0-16 gpm.

B. **Gauges.** Each of the chlorine gas feeders shall be equipped with two remote mounted water pressure gauges and one panel mounted vacuum gauge. The gauges shall be the diaphragm type having a silver diaphragm. The Bourdon

tube and diaphragm compartment of the vacuum gauges shall be filled completely with special oil. The gauges shall be approximately 3 inches in size with plastic windows. The vacuum range of vacuum gauges shall be compatible with the injector. The water pressure gauges shall have a range of 0 to 200 psi. Each gauge shall be installed with a header valve. Vacuum gauges and vacuum gauge header valve materials shall be suitable for use with chlorine gas.

C. **Emergency Kit.** One emergency Type B repair kit as recommended by the Chlorine Institute.

2.5 SAFETY EQUIPMENT

A. **Chlorine Detector.** Provide two (2) wall mounted chlorine detector suitable for use in the Chlorine Room and Chlorination from that shall monitor for the presence of chlorine gas in the ambient atmosphere using a single gas detector for each. The detector shall consist of a remote sensing unit and an electronic circuitry control box. The remote sensor unit shall include a replaceable electrolyte capsule which forms an electrical cell sensitive to the presence of chlorine in ambient air. The detector shall trigger a "warning" condition when the chlorine concentration exceeds 1 part per million (ppm) and an "alarm" condition at 3 ppm. These condition levels shall be field adjustable between zero (0) and ten (10) ppm. The warning and alarm conditions shall be indicated by two separate lights mounted on the face of the NEMA 4X control box. Two 120-volt, 3-ampere contacts shall be provided for both the alarm and warning conditions. The alarm and warning lights shall be push-to-test type that remain activated until the situation is corrected and a reset button, mounted on the control box, is pressed. A malfunction of the remote sensor units shall be indicated by a warning light on the front of the control box. The detector shall operate on 120-volt, 60-hertz, single-phase power and include an internal battery backup that will automatically maintain operation of the detector for a minimum of 12 hours following power failure with the power supply module continuously and automatically recharging the battery. The sensor shall not require the addition of chemical and be an electrochemical type that is powered from the receiver through a two-conductor cable of sufficient length for the installation. This same cable shall transmit a current pulse position signal representative of gas concentration back to the receive and fitted with an integral electrochemical gas generator that automatically produces a specific gas ample to test the sensor.

1. The chlorine detector shall be Wallace & Tiernan Acutec 35 or equal, and mounted per the manufacturer's recommendations. The detector shall include an auto test kit as recommended by the manufacturer.

B. **Masks and Air Tanks**. Provide two 30-minute supply, self-contained compressed air tanks with full face masks suitable for use in chlorine gas atmosphere. Gas masks shall be NIOSH approved. Provide two extra 30-minute compressed air supply tanks and waterproof wall-mounted cabinet for storage of all safety equipment. Compressed air tank shall include an audible warning device which signals a diminishing tank air supply. A steel cabinet for storage of

the two masks and air tanks shall be provided and wall mounted where directed by the Engineer/Architect. The cabinet shall be a NEMA 12 enclosure.

2.6 SPARE PARTS AND TOOLS

A. **Gas Feeder Preventive Maintenance Kits**. Provide one kit for each gas feeder. Kit shall contain all parts necessary for repair of feeder including O-rings, grab rings, diaphragms, gaskets, washers, tube of silicone grease, tube of halocarbon grease, and service tag.

B. **Vacuum Regulator Preventive Maintenance Kits**. Provide one kit for each vacuum regulator. Kit shall contain all parts necessary for repair of vacuum regulator including O-rings, diaphragms, stem spring, gaskets, rod detents, tube of silicone grease, and service tag.

C. **Injector Preventive Maintenance Kits**. Provide one kit for each injector. Kit shall contain all parts necessary for repair of injector including O-rings and diaphragm.

D. **Chlorine Detector Spare Parts**. Provide one spare sensor and two sets of spare fuses.

E. **Tools**. Provide maintenance tools as required for the chlorination equipment specified herein.

PART 3 - EXECUTION

1.2 EXAMINATION

A. **Site Verification of Conditions**. Verify that surfaces and site conditions are ready to receive work and the following conditions:

1. Structure is clean and ready for equipment, piping, and other items to be placed.
2. Anchor bolts are of appropriate size and properly located in accordance with approved shop drawings and manufacturer's instructions.
3. Electrical conduit cast in concrete is properly sized and located.

B. **Responsibility**. Beginning the installation means the installer accepts the existing surfaces and conditions.

1.3 PREPARATION

A. **Maintain chlorine supply** continuously except for carefully scheduled downtimes of less than 4 hours. Carefully plan and prepare work so that the chlorine system downtime is minimized and will not adversely impact Owner's operation.

B. **Have means and procedures in place** so that no damage will occur to the Owner's chlorine gas supply system during the removal of old equipment and installation of new.

C. **Protection**. Protect adjacent equipment, piping, and valving against damage from the chlorination equipment installation where required.

D. **Manufacturer's Instructions**. Complete preparatory work in accordance with manufacturer's instructions prior to equipment installation.

3.1 **INSTALLATION.** Fabrication and installation of the chlorination equipment specified herein shall be as shown on the plans and in accordance with approved shop drawings and the manufacturer's recommendations. Refer to Division 26 for all electrical power and control connections.

3.2 **FIELD QUALITY CONTROL**

A. **Inspection**. Notify and coordinate with the equipment manufacturer in a timely manner in order for them to conduct their inspection, servicing, testing, and instruction as required in this specification section.

B. **Manufacturer's Field Service**. The manufacturer shall provide a qualified representative to inspect the completed installation; service the equipment; adjust, field test, and operate the equipment under all design conditions; instruct the Owner's personnel in proper operating and maintenance procedures; and provide Owner with a written certificate of approval in accordance with Section 01 33 00. The representative shall spend at least two (2) 8-hour day performing the required services and submit a manufacturer's representative report for each site visit.

C. **Operational Demonstration**. The testing procedures shall be defined by the Contractor and agreed upon by the Owner. Notify and afford the Owner the opportunity to witness the testing procedures. Provide all test materials, equipment, and water required for testing at no additional cost to the Owner. Tests shall be in accordance with Section 01 79 00 unless specified otherwise.

1. Dry Tests.

    a. Chlorine Gas Feeders. Check and test moving compartments of equipment for proper positioning, alignment, and motion.
    b. Scale. Verify scale reading with test weights.
    c. Chlorine Detector. Test alarm and warning lights with normal power and with internal battery backup.

E. **Site Tests**

1. Methods. Field tests shall be in accordance with Section 01 75 16.
2. Field-test the chlorine gas supply system with chlorine ton cylinders supplied by the Owner and other appurtenances. This field test shall be conducted by the manufacturer's representative. The test shall show that the chlorine gas supply system shall reliably withdraw chlorine gas from

the ton cylinders, the chlorine supply piping is operating under a vacuum downstream of the vacuum regulator check unit, and that the automatic switchover system operates properly and as specified.

3. Show that the two (2) ton container scales accurately measure the weight of the ton cylinders and the amount of chlorine therein and transmit these values to the main operator interface terminal.
4. Show that the chlorine gas detector accurately measures the concentration of chlorine gas in the atmosphere, alarms as specified, and transmits these values to the main operator interface terminal.
5. Operate and show that the emergency shutoff valves operate locally and remotely as specified.
6. Simulate a ton container leak and show that the emergency shutoff valves will automatically close as specified.

3.3 **ADJUSTING**

A. **Test Results**. If the results of the field tests do not show successful operation of the chlorination equipment, repair, adjust, modify, or replace the equipment in accordance with the manufacturer's instructions at no additional cost to the Owner until the equipment and systems are operating as required and the tests are successfully completed.

3.4 **FIELD-FINISHING**

A. **General**. Comply with Section 09 90 00, "Painting."

B. **Field-Finishing**. Finish-coat all structural steel surfaces in conformance to Section 09 90 00, "Painting." Touch-up painting shall be in accordance with the manufacturer's instructions as approved.

3.5 **INSTRUCTION OF OPERATING PERSONNEL.** Training shall be conducted in accordance with Section 01 79 02 and shall include all equipment specified in this section and all related electrical and instrumentation equipment. Two courses, each taking 4 hours, shall be provided. The second course shall follow the first by 3 to 4 weeks.

END OF SECTION

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SECTION 46 33 01

LIQUID CHEMICAL FEED EQUIPMENT

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 1 and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide all labor, tools, equipment, and materials necessary to furnish and install the chemical feed equipment at the City of Canton's Sugar Creek Water Treatment Plant in accordance with the plans and specifications.

1.3 **QUALITY ASSURANCE**

A. **Standards**. Materials and workmanship shall be in accordance with the following standards as referenced herein.

1. ANSI – American National Standards Institute.
2. ASTM – American Society for Testing and Materials.
3. NEMA – National Electrical Manufacturers Association.
4. NIOSH – National Institute for Occupational Safety and Health.

1.4 **SUBMITTALS**. Submit all required documents and materials in accordance with Section 01 33 00, this section, and the individual equipment specifications.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Schedule. No other submittal packages related to this equipment can be approved before this one.

2. Submittal Package Contents.

a. Product data.

b. Shop drawings.

c. Performance Data.

1) Based on actual tests of similar equipment and include sufficient data to demonstrate suitability of both the pump and driver for the conditions specified.
2) The data shall include the type and make of pump, size, capacity, motor horsepower, motor speed, and performance curve.

B. **Submittal Package No. 2 – Start-Up Preparation Documents**

1. Schedule. This submittal package must be approved before the equipment start-up may take place.

2. Submittal Package Contents.

a. Initial operation and maintenance (O&M) manual.
b. Start-up request.
c. Training schedule.
d. Instructor qualifications.
e. Instructional materials.

C. **Submittal Package No. 3 – Operational Demonstration Preparation Documents**

1. Schedule. The operational demonstration cannot begin until these documents are approved.

2. Submittal Package Contents.

a. Manufacturer's representative reports from equipment start-up.
b. Revised O&M manuals.
c. Operational demonstration request.
d. Sample operational demonstration log.

D. **Submittal Package No. 4 – Operational Demonstration Documents**

1. Schedule. The operational demonstration must be completed before these documents can be submitted.
2. Submittal Package Contents. Completed operational demonstration log.

1.5 **JOB CONDITIONS**. All equipment and materials furnished to provide the required chemical feed systems shall be suitable for the scheduled chemical service.

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 01 60 00.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **FEED EQUIPMENT**

A. **Peristaltic Metering Pumps**

1. Manufacturer. Subject to compliance with the specifications, provide the pumps from one of the following approved manufacturers.

a. Blue-White
b. Watson-Marlow.

c. Vector.
d. Masterflex
e. Eccentric.

2. Description. The chemical metering pumps shall be of the positive displacement peristaltic type utilizing a flexible tube and that does not require a spring-loaded roller or track. The metering pump shall have the capacities described in the Equipment Schedule. The pumps shall be shelf mounted per the manufacturer's recommendations for the proposed chemical with a drain that is routed to the existing sump. The Contractor shall provide a shelf capable of supporting the three (3) peristaltic pumps, piping, and valves that also includes a lipped edge to contain any liquid that leaks from the pumps or piping. Other pipe appurtenances specified shall be mounted to the wall by the Contractor. Contractor shall mount to the shelf to the wall and install piping and valve to drain any liquid on the shelf to the to drain to the existing sump.

3. Materials.

   a. All hardware shall be Hastelloy C or a material that is corrosion resistant to the chemical specified.
   b. The pump tubing shall be polyethylene or PVC as recommended by the manufacturer and shall be of 64 Shore A durometer.

4. Fabrication and Assembly.

   a. Each pump shall consist of a fixed track with hinged or removable guard door, tube retainer mechanism, roller rotor assembly with guide pins and integral variable-speed drive.
   b. The process fluid shall be in contact with only the inside of the pump tubing.
   c. Two molded squeeze rollers and two (2) alignment rollers shall hold the suction and discharge and optimized for performance.
   d. Tube clamps requiring tools are not acceptable.
   e. The tubing shall be replaceable with no disassembly of the pump head and without the use of tools.
   f. Flow through the housing shall be in the direction of the rotor rotation which can be reversed.
   g. Self-priming when completely dry with a suction lift capability of up to 25 feet of water.
   h. Capable of running dry without damaging effects to the pump or hose.
   i. Use no check valves, diaphragms or dynamic seals in contact with the pumpage.
   j. Each pump shall be equipped with a tube failure detection sensor. Tube failure detection system shall not trigger with water contact. Float type switches shall be used. Process fluid waste ports or leak drawings shall not be provided.

5. Drive.

a. Drive shall be 120-volt rated for continuous 24-hour operation at ambient temperature to 40 degrees Celsius (° C.).

b. Pump drive shall be close-coupled and self-aligning, requiring no flexible couplings. Enclosure shall meet NEMA 4X (IP66) ingress protection rating.

c. Drive shall have a membrane keypad with control as follows:

1) Liquid crystal device (LCD) display of pump speed (revolutions per minute [rpm]) or flow rate (milliliters per millimeter [ml/mm])
2) Keys for start, stop, speed increment, speed decrement, programming, forward/reverse direction, rapid prime, and programming.
3) Menu-driven on-screen programming of manual or auto control, flow and remote signal calibration, and programming.
4) Programmable auto-restart feature to resume pump status after power interruption.
5) Programmable keypad lock to allow operator to lock out of all keys except start/stop.

d. Drive shall include the following remote features.

1) Receive start/stop command from dry contact closure at programmable logic controller (PLC) panel to call pump on and off.
2) Accept 4-20 milliampere (mA) analog signal from PLC for flow pacing.
3) Dry contact closure for sending pump status (on/off) back to PLC.
4) Tachometer output selectable as either 0-5 volt-direct-current (Vdc) analog or 5-V square wave frequency output.
5) In addition to the dry contact closure, a normally closed float switch shall be mounted on the pump to provide pump or hose failure detection.

e. Start/stop contact shall be functional in either manual or analog mode.

f. Drive motor shall be servo permanent magnet dc with integral gearbox. Motor brushes shall be rated for 10,000 hours to first inspection based on running continuously at full speed with largest tube size. Motor shall be rated for washdown duty.

6. Installation. Each metering pump shall be installed per manufacturer's instructions.

B. **Pump Accessories**

1. Components for the three (3) shelf mounted peristaltic pumps shall be wall mounted that includes, but not limited to, piping, valves, piping accessories, wiring, junction boxes, disconnects, pressure release valves and any other components required.
2. The shelf shall be manufactured of fiberglass-reinforced plastic (FRP) or high-density polyethylene with adequate supports for all equipment. The entire skid shall be self-supporting and provide sufficient rigidity to reduce pump vibration. Supports shall be mounted to the wall by the Contractor and utilize anchor bolts. Epoxy grout shall be used if required.
3. All piping contained be supported by the Contractor in accordance to the requirements herein.
4. Each pump shall be equipped with a power disconnect switch a specified in Division 26 and be prewired from disconnects to each pump motor.
5. Shelf shall be equipped to contain any chemical leakage that occurs within its limits with a drain port with associated valve. Contractor shall connect the drain port from the pump shelf to the existing sump.
6. The suction and discharge connections shall be orientated to ease of access for maintenance personnel.
7. Accessories:
    a. All components that come in contact with the specified chemical shall be compatible with those chemicals.
    b. All components and hardware that do not come in contact with the specified chemical are to be Type 316 Stainless Steel.
    c. **Calibration Column.** Shall be of clear PVC construction, graduated in gallons. Cylinder shall be sized to allow the pump to withdraw the total contents of the column in approximately 1-2 minutes based on the pump flow rate provided in the equipment schedule. An outlet vent shall be provided.
    d. **Pulsation Dampener.** Provide one (1) pulsation dampener per pump as recommended by the manufacturer. Pulsation dampener shall be suitable for use with the chemical listed herein.
    e. **Pressure Gauge with Guard.** Prove one (1) pressure gauge. Pressure switch shall shut-down pump on high discharge pressures. Pressure gauges shall be as specified in Division 40 with the exception that a diaphragm seal housing shall be PTFE diaphragm with a PVC housing suitable for use the chemical specified herein. Pressure gauge shall be sized accordingly to hand the maximum pressure of the specified pump in the equipment schedule.
    f. **Strainer.** Shall be a PVC Y-type strainer with removable screen that is compatible with the chemical specified herein. Screen shall be removable through the strainer leg without disassembling the piping.
    g. **Flow Indicator.** Shall be in the discharge side of the piping system to provide a visual indication of fluid movement through

the system. The flow indicator body shall include a PVDF ball stop and be secured to the piping system with CPVC connectors and Polypropylene unions.

h. **Check Valve.** Shall be located on the discharge side of the piping system to prevent the back flow of fluid through the system. That check valve shall be PVC.

i. **Pressure Relief Valve.** Shall be located on the discharge side of the piping system to prevent excessive pressure in the system. The fluid shall be returned to the inlet side of the system if the pre-set maximum pressure is exceeded. The valve shall be PVC with PTFE diaphragm seal and pressure adjusted with screw and lock nut constructed of polypropylene that is adjustable between 10-150 PSI. An outlet safety vent port shall also be equipped on the unit. The pressure relief valve discharge shall be connected to the Day Tank.

j. **Pump Connections.** Shall be flexible, reinforced braided PVC tubing rated for 200 PSI maximum continuous duty and terminated to half unions with hose clamps compatible with the chemical specified.

2.2 STORAGE FACILITIES

A. Storage Day Tanks

1. Fabrication and Assembly.

   a. Vertical, flat bottom, dished top.
   b. Minimum capacity and materials as listed in the Equipment Schedule.
   c. Self-supporting when filled.
   d. Translucent to allow observation of the liquid level.
   e. Clearly marked in 10-gallon increments.
   f. Provide access openings in the cover for all piping and accessories as specified.
   g. Tank shall include a minimum ¾ inch drain with valve at the bottom. Contractor shall install piping from the day tank to the existing sump.
   h. If required, reinforcing ribs shall be per manufacturer's recommendations.
   i. FRP tank joints shall be made with heavy reinforced lay-ups for structural stability and to prevent leakage.
   j. FRP tank shall have sufficient resin on all surfaces to prevent fiber exposure.
   k. The following features shall be included:
      1) Fill, overflow, drain port, and other appurtenances as shown on Contract Drawings.
      2) Quick access on top of tank.
      3) Proper venting for chemical storage.

2. Materials.

a. Fiberglass-Reinforced Polyethylene (FRP) Tanks.

1) Manufacturer. Subject to compliance with the specifications, provide the tanks from one of the following approved manufacturers.

a) Plas-Tanks.
b) Design Tanks.
c) MFG Justin Tanks.
d) Raven Industries.

2) Furnish and construct in accordance with AWWA D120 “Thermosetting FRP Tanks” standard.

3) Construct of thermoset polyester, vinyl ester, or epoxy resin selected by the manufacturer, and glass reinforcement that is adequate to withstand the effects of scheduled chemicals.

4) Selected resin monolithic throughout the tank.

5) Post-cure the tanks at 180 degrees Fahrenheit (° F.) for a minimum of 4 hours.

6) The manufacturer shall furnish a written certification verifying compliance with all curing requirements.

7) Manufacture by the filament-wound method and in accordance with ASTM D 3299.

b. Tank shall be provided with a high level alarm that illuminates when the tank is full to notify operators when the tank is full.

c. HDXLPE/ HDLPE Tanks:

1) Manufacturer. Subject to compliance with the specifications, provide the tanks from one of the following approved manufacturers.
a) Poly Processing Company
b) Snyder Industries, Inc.
c) Or approved equal.
2) Furnish and constructed in conformance with ASTM D1998, Standard Specification for Polyethylene Upright Storage Tanks.
3) Tanks shall be rotationally molded, vertical, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section and vertical with flat bottoms.
4) High density cross-linked polyethylene resin used in the tank manufacturer shall contain ultraviolet stabilizer as

recommended by the resin manufacturer (Poly CL™ or approved equal). The tank material shall be rotationally molded and be a resin that is commercially available at the time of the tank manufacture.

3. Fittings:
   a. Integrally molded flanges shall be installed on the sidewall of the tank to allow full drainage. These shall be integrally molded into the tank during the rotation molding process and be seamless, flanged, and manufactured from the same material as the tank.
   b. Bolted flange bulkhead fittings shall be installed on the upper two-thirds of the sidewall and constructed with one 150 LB flanged inside the tank and one flange ring installed outside the tank. Flange shall be socket or threaded.
   c. Gaskets: Viton
   d. Nuts, Bolts, and Hardware: Hastelloy C.

B. **Tote Scales**

1. Manufacturer.

   a. Tote Scales. Subject to compliance with the specifications, provide tote scales from one of the following approved manufacturers.

      1) Scaletron Model 4040 with Model 1020 controller.
      2) Force Flow Model 50-DR50 TB with SOLO G2.
      3) Interweigh Systems, Inc., Low-Profile Floor Scale.
      4) Eagle Microsystems Low-Profile Platform Scale.
      5) Fairbanks Aegis Stainless Steel Floor Scale.

2. Scale Platform.

   a. Digital readout/electronic single-load cell type.

   b. Tote Scale Size. Minimum 48" x 48".

   c. Resistant to moisture, chemicals, abrasion, impact, and UV light.

   d. Polyester dry-powder-coated steel frame with a minimum dry thickness of 80 mils.
   e. Stainless steel hardware.

   f. Solid polyvinyl chloride (PVC) or stainless steel decking.

   g. Provision for securing weigh frame to floor.

   h. Weight shall be transferred via a pivoted platform to a single National Type Evaluation Program (NTEP) approved load cell of the shear beam strain gauge type.

i. Minimum tote scale capacity shall be as listed in the equipment schedule herein.

3. Cable. Connect load cell to indicator with a minimum-15-foot flexible cable to allow remote indicator installation.

4. Indicator.

a. Monitor one channel.
b. Remote mounted backlit liquid crystal display (LCD).
c. NEMA 4X, Underwriters' Laboratory (UL) approved enclosure.
d. Keypad-operated and menu-driven to avoid compromising the NEMA 4X seal.
e. 110 volts alternating current (Vac).
f. Minimum five-digit numerical display.
g. Monitor chemical by weight (pounds) or volume (gallons).
h. Dual-mode TARE key to enter the tare weight of the vessel or the net weight of the chemical.
i. Allow recalibration without the need to apply field test weights.
j. A user-adjustable filter function shall stabilize display in the event of vibration in the immediate vicinity of the scale.
k. Output net weight via a 4-20 milliampere (mA) signal and full-scale output shall be user-adjustable via the keypad.
l. Full-scale accuracy shall be better than 1/4 of 1 percent.

5. Shall be equipped with an alarm that illuminates that notifies the operator when the tank reaches a specified weight indicating that day tank has reached its capacity.

2.3 ACCESSORIES

A. **Piping**. All chemical feed piping shall be Schedule 80 PVC pipe in accordance with Section 40 05 13.73, "Process Piping SCH 80 PVC," unless otherwise shown or noted. Solvent shall be as recommended by the manufacturer for prevailing conditions.

B. **Valves and Accessories**

1. Install valves and accessories in the piping system as shown. All valves and accessories shall be easily accessible.

2. Valves.

a. Ball Valves. In accordance with Section 40 05 23, "Process Valve," and unless noted otherwise, all ball valves shall be PVC body.
b. Check Valves. In accordance with Section 40 05 23, "Process Valves," and unless noted otherwise, all check valves shall be PVC ball check valves.

c. Safety Equipment.

1) Provide the following safety equipment suitable for use with sodium bisulfate and approved by NIOSH.

a) One pair of chemical safety goggles, antifog, indirect vent, suitable for use over prescription glasses. ANSI Z.87.1. Lab Safety Supply RA833F or equal.
b) One full-face shield with ratchet-adjustable headbands, Connelly M73185 headgear with M73186 clear plastic treated with Uvex 4C antifog, antiscratch, antistatic, and anti-ultraviolet (UV) or equal.
c) One long-sleeve neoprene apron, Lab Safety Supply RA-6989 or equal.
d) One pair of neoprene gloves, Wallace and Tiernan U-13628 or equal. Size as selected.
e) One pair of neoprene boots, over-the-shoe type, 17-inch height, size as selected.

2) Provide wall-mounted fiberglass storage cabinet for the safety equipment. Locate where directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Before installation of equipment, verify that:

1. All clearances have been met.
2. Bases, anchors, supports, and openings are located correctly and are of the proper size and material.

B. **Variations**. Correct any variations from the requirements shown or required by the manufacturer at no additional cost to the Owner. Submit all methods of correction in writing.

C. **Visual**. With the Owner and/or Engineer, inspect the equipment for visual deficiencies.

3.2 **PREPARATION**. Protect all surface areas from damage. Protect all finished floors with a waterproof, chemical-resistant cover to prevent staining from chemicals.

3.3 INSTALLATION

A. **General**. Install all equipment in accordance with the manufacturer's instructions and the conforming shop drawings. Manufacturer’s representative shall field test and calibrate the equipment to assure that the system operates within the requirements specified herein and to the Owner’s satisfaction.

B. **Set anchor rods** in accordance with the approved manufacturer's conforming submittals.

C. **Tank Cushioning**

1. Coordinate location of concrete box-outs as required for tank drain fittings.
2. Foundation shall be capable of providing full and uniform support over the entire bottom area.
3. Prior to installation of the tanks, lay a minimum of two layers of 30-pound roofing felt over the entire foundation in alternating directions.

D. **Piping and Valves**

1. Layout.

   a. Provide all offsets, fittings, and accessories for a complete system.
   b. Install all piping parallel to or at right angles to walls and floors.
   c. Provide sleeves where passing through floor or walls.

2. Supports. In accordance with Section 40 05 13, "Process Piping, General," except construct all pipe supports of fiberglass, PVC, or Hastelloy C only.

3. Pipe Insulation. In accordance with Section 40 42 13, "Process Piping and Equipment Insulation."

4. Imperfections. Remove all burrs and sharp edges from the pipe before installation. Do not use any pipe that has been damaged in any manner.

5. Unions. Install piping using unions at all valves and equipment so as to facilitate removal.

6. Gaskets shall be Viton. Bolts, nuts, and other hardware shall be Hastelloy C.

E. **Interface with Other Products**

1. Complete all electrical power and control connections under Division 26, "Electrical."
2. Install and connect all piping.
3. Perform field quality control as specified in this specification.

3.4 **REPAIRS/RESTORATION**. Repair or replace any damage to the equipment or chips, dents, scratches, stains, or other disfiguring of surrounding floors, walls, and/or accessories to the satisfaction of the Owner and/or Engineer at no additional cost to the Owner.

3.5 FIELD QUALITY CONTROL

A. **Manufacturer's Field Service and Start-Up**. A qualified representative of each equipment manufacturer shall start up the equipment in accordance with Section 01 79 00, "Start-up, Demonstration, and Training," including all field testing. Representative shall spend at least two (2) days for a duration of eight (8) hours performing the required services. The manufacturer representative shall provide assistance in the installation of the equipment and check for completed installation, start-up, and necessary training as required by Contract Documents.

B. **Field Tests.** After the Owner has agreed that the equipment installation is complete, the Contractor and a qualified field service representative of the manufacturer shall conduct a running test of the pumps and controls in the presence of the Owner to demonstrate that each pump and its controls will function correctly.

C. Running Test:

1. All pump units together with their controls shall be field tested. Tests shall demonstrate that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by the Contractor.
2. Conduct on each pump for a minimum of three (3) hours. At a minimum, each pump shall be tested for conformance with the performance criteria listed for each pump.
3. The complete assembly shall be properly aligned, exhibit no excessive vibration and not operate within any natural frequencies.
4. In the event that the manufacturer is unable to demonstrate that equipment meets the requirements of the tests, the Contractor shall adjust, modify and retest the equipment as often as necessary in order to meet the specified requirements at no additional cost to the owner.

3.6 CLEANING. In accordance with Section 01 74 23, "Cleaning."

3.7 CLOSEOUT ACTIVITIES

A. **Demonstration**. Perform an operational demonstration in accordance with Section 01 79 00.

B. **Training**. Conduct training in accordance with Section 01 79 00 and as required in the individual equipment sections.

3.8 PROTECTION

A. **Requirements**

1. Be responsible for provisions to protect the equipment after installation, but before acceptance by the Owner.
2. Protection of the equipment shall include provisions during installation and testing of nearby piping, valving, or other adjacent equipment.
3. Remove all protective measures installed after acceptance of the project.

3.9 ATTACHMENTS

A. **Equipment Schedule**

Chemical Information		
Name	Hydrofluosilicic Acid (Fluorosilicic Acid)	Sodium Bisulfite*
Molecular Formula	H_2SiF_6 (aq)	$NAHSO_3$
Solution Strength (%)	23-25	34-42
Specific Gravity	1.25	1.31 to 1.37
pH	1.5 – 2.0	3.6 to 4.6
Feed Equipment		
Pump Type (Peristaltic/Diaphragm)	Peristaltic	Peristaltic
Quantity	3	2
Mounting	Shelf Mounted	Shelf Mounted
Maximum Pump Capacity (gph)	4.5	17.5
Control (Manual/Automatic)	Manual	Manual
Paced by	-	-
Calibration Column Capacity (ml)	N/A	N/A
Discharge Pressure (psi)	100	110
Storage Day Tank		
Quantity	1	N/A
Type	FRP, HDXLPE, or HDLPE	
Minimum Working Capacity (gal)	80	
Fittings	Flanged	
Scales		
Type (Drum/Tote/Bulk)	Tote	N/A
Minimum Capacity (lbs.)	1,500	
Quantity	1	
Feed Rate (Provided for Information Only, to be Field Adjustable)		
Recommended (mg/l)	1.00	N/A
Raw Water Content (mg/l)	0.26	N/A
Design (mg/l)	0.74	N/A
Combined Design Feed Rate (GPH)	2.6	0.21
Combined Peak Feed Rate (GPH)	3.3	N/A

*Refer to Dechlorination Drawings for additional requirements.

END OF SECTION

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APPENDIX I - GEOTECHINCAL ENGINEERING REPORT

Geotechnical Engineering Report

Sugar Creek WTP & Wellfield Improvements
Strasburg, Tuscarawas Co., Ohio
Revised June 24, 2021
Terracon Project No. N6215094

Prepared for:
Burgess & Niple, Inc.
Painesville, Ohio

Prepared by:
Terracon Consultants, Inc.
Parma, Ohio

June 10, 2021
Revised June 24, 2021

Burgess & Niple, Inc.
100 W Erie St.
Painesville, Ohio 44077

Attn: Mr. Jeff Marnicio, P.E. – Project Manager
P: (440) 354-9700 x3295
E: jeff.marnicio@burgessniple.com

Re: Geotechnical Engineering Report
Sugar Creek WTP & Wellfield Improvements
9649 Dolphin Street SW
Strasburg, Tuscarawas Co., Ohio
Terracon Project No. N6215094

Dear Mr. Marnicio:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PN6215094 dated April 14, 2021. This revised report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of both shallow and deep foundations for the proposed project. This report replaced the original Geotechnical Engineering Report completed for this project, dated June 10, 2021.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

STATE OF OHIO
Thomas F. Mc Donnell
#E-70954
REGISTERED
PROFESSIONAL ENGINEER
6/24/2021

Thomas F. McDonnell, P.E.
Principal

for
Chett A. Siefring, P.E.
Manager – Geotechnical Services

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Sugar Creek WTP & Wellfield Improvements

9649 Dolphin Street SW

Strasburg, Tuscarawas Co., Ohio

Terracon Project No. N6215094

June 24, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed well field and water treatment plant (WTP) improvements for the Sugar Creek Plant of the Canton Water Works located at 9649 Dolphin Street SW in Strasburg, Tuscarawas Co., Ohio. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Demolition considerations
- Dewatering considerations
- Utility construction
- Foundation design and construction
- Excavation considerations
- Seismic site classification per IBC
- Lateral earth pressures
- Frost considerations

The geotechnical engineering Scope of Services for this project included the advancement of seven test borings to depths ranging from approximately 15 to 40 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 9649 Dolphin Street SW in Strasburg, Tuscarawas Co., Ohio. Latitude: 40.6410 Longitude: -81.5416 (approximate) See **Site Location**
Existing Improvements	Water treatment plant and series of ten wells for drawing water from the aquifer.
Current Ground Cover	Grass within the well field and lawn/asphalt pavement in front of the water treatment plant (WTP).
Existing Topography	Grades within the existing wellfield are relatively flat to gently sloping downward from the north to the south. Surface elevations within the well field vary between about 937 feet and 933 feet, MSL. The topography slopes upward from the well field east to the WTP. Surface elevation at the WTP is approximately 971 feet, MSL.
Geology	At the time of preparing our proposal, our experience near the vicinity of the proposed development or geologic maps indicated subsurface overburden conditions within the project area consist of three zones. Granular outwash deposits of sand and gravel were expected in the area of the well field boring locations, except Well #10. At Well #10, alluvium deposits of silt and sand were anticipated. The same outwash deposits as in the majority of the well field were also expected near the WTP, but overlain by loess, wind deposited soils known to be gritty, lightweight and porous. The overburden soils are underlain by shale bedrock at depths expected to vary between about 175 feet and 300 feet below current surface grades in the well field and about 50 feet near the WTP. Following the completion of field exploration and site characterization services, granular outwash deposits were encountered at all of the wellfield locations, consistent with these expectations. The alluvium soils expected at Well #10 were not present, however. Additionally, loess soils were not encountered in the test boring conducted near the WTP. At this location, fill soils consisting of silty to clayey sand were encountered above the outwash. Undocumented fill was also present at Well #8. As expected, bedrock was not encountered within the depth explored.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. Our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Request for Soils Investigation Proposal and plan sheets WC-1, WC-7, WC-10, WP-8 and C-14 (annotated) were sent to us via email on April 9, 2021. Information pertaining to the design of the foundation for the planned elevator shaft was provided via email on June 18, 2021.
Project Description	Replacement of existing valve vaults at specific well point locations, new water line, and the addition of an elevator at the main entrance of the WTP.
Proposed Structures	The project includes replacement of the existing valve vaults with new, pre-engineered buildings with a footprint of approximately 300 square feet. A new, 20-inch diameter, ductile iron pipe water line will be installed to connect several of the existing well points. A new elevator will be constructed adjacent to the main entrance of the WTP.
Building Construction	Anticipated to include pre-engineered buildings at the well points and concrete masonry unit and/or structural steel framed at the elevator.
Finished Floor Elevation	Anticipated to be near the existing surface grades at each structure location, including: ■ Well point buildings – 933± feet to 937± feet, MSL ■ Elevator – 971± feet, MSL
Maximum Loads	Final anticipated loads have not been provided. For the purposes of analysis and preparation of this report, the following maximum loads have been considered: ■ Columns: 25 kips ■ Walls: <1 kip per linear foot (klf) ■ Slabs: 125 pounds per square foot (psf) Additionally, we understand the elevator is planned to be supported by two drilled shaft foundations, each expected to support a maximum load of about 55 kips.
Grading/Slopes	Based on the anticipated finish floor elevations noted above, only minimal grading (i.e. 2± feet of cut and fill) will be required to develop final grade. Final slope angles of no steeper than 3H:1V (Horizontal: Vertical) are expected.
Below-Grade Structures	The pre-engineered structures and elevator shaft may extend below the ground surface to accommodate the new waterline connections.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at

each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Surface materials	Aggregate and/or Topsoil
2	Existing Fill	Loose to medium dense, clayey to silty sand
3	Native Granular Soils	Loose to dense, poorly to well graded sands, silty to clayey sands and well graded gravel
4	Native Cohesive Soils	Medium stiff to very stiff, lean clay and silt

Groundwater observations at individual boring locations are indicated on the boring logs in **Exploration Results**, but in general water was observed while drilling at depths between about 8 feet and 14 feet below the ground surface.

GEOTECHNICAL OVERVIEW

Site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses support of the building bearing on loose or better relative density granular soils or medium stiff or better consistency cohesive soils. Undocumented fill soils were encountered in test borings SB-08 and SB-PLT to a depth of approximately 3 feet and 12 feet below current surface grades, respectively. Support of foundations for the planned elevator on or above existing fill materials is discussed in this report. However, even with the recommended construction procedures, there is inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill, will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

The **Deep Foundations** section present recommendations for the design and construction of the drilled shaft foundations to support the new elevator.

Recommendations for the design of below grade walls is included in the **Lateral Earth Pressures** section.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include selective demolition, clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations.

Site Preparation

After any existing surface structures have been demolished, it is recommended that all buried objects, remnants of preexisting structures and pavements encountered within the proposed development areas be removed in their entirety. Any existing utilities should also be removed or relocated. Once removed, it is imperative that backfilling is suitably undertaken to ensure the long-term performance of the new structure. Historical evidence indicates that new structures placed over the remnants of previous construction or poorly compacted backfill often result in the new structure performing poorly either with evidence of cracking within wall, foundations, and/or floor slabs or in severe cases settlements beyond the tolerable limits of the structure.

Following the structure demolition and the removal of buried features, any undeveloped areas of the proposed building areas should be stripped of their vegetation and topsoil along with any areas of rooting.

The exposed subgrade should then be proofrolled with an adequately loaded vehicle such as a smooth drum roller with a minimum drum weight of 10 tons (for granular soils) or a fully-loaded tandem-axle dump truck with a minimum gross vehicle weight of 20 tons (for cohesive soils). The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be moisture conditioned and recompacted or removed and replaced with engineered fill.

Existing Fill

As noted in **Geotechnical Characterization**, borings SB-078 and SB-PLT encountered existing fill to depths ranging from about 3 to 12 feet. The fill appears to have been placed in a controlled manner, but we have no records to indicate the degree of control. Support of footings on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, there is inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill will, not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

Fill Material Types

Earthen materials used for engineered fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Parameters (for Engineered Fill)
Existing Fill	Varies	All locations and elevations, pending approval of the Geotechnical Engineer prior to use
Native Cohesive	CL, CL-ML, ML	All locations and elevations, except that ML soils should not be used within 3 feet of planned finish subgrade elevations due to frost susceptibility
Native Granular [2]	SP, SW, GW, SC, SM	All locations and elevations
Granular	GW, GM, GC, SW, SM, SC	All locations and elevations

1. Engineered fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Fill Compaction Requirements

Engineered fill should meet the following compaction requirements.

Item	Requirement
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2]	98% of max. dry density
Water Content Range	Cohesive: -2% to +3% of optimum Granular: workable moisture content [3]

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254).
3. Sufficient to facilitate compaction without the material pumping or rutting under the weight of the construction equipment.

Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. Under pavement and building areas, we recommend that the

trenches be backfilled using well graded, granular materials containing less than 15% fines passing the No. 200 sieve. Backfill should be placed in maximum 6-inch thick loose lifts and be compacted using hoe packs, jumping jacks, plate tampers or other suitable compaction equipment.

Compaction requirements for bedding and backfilling around utilities may need to be adjusted to the pipe material type and the pipe manufacturer's bedding and backfill material recommendations.

Grading and Drainage

All grades must provide effective drainage away from the buildings during and after construction and should be maintained throughout the life of the structures. Water retained next to the buildings can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roofs should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted, as necessary, as part of each structure's maintenance program. Where paving or flatwork abuts a structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structures are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

The groundwater table is not anticipated to affect shallow excavation efforts; however, if elevated groundwater levels are intercepted during construction, a temporary dewatering system consisting of sumps with pumps could be necessary to achieve the required depth of excavation.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. A minimum of three density and water content tests should be performed for each lift of fill in the planned building areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing pressure [1, 2]	2,000psf

Item	Description
Required Bearing Stratum [3]	Loose or better relative density granular soils, medium stiff or better consistency cohesive soils, or new engineered fill extending to these materials
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 14 inches
Ultimate Coefficient of Sliding Friction [4]	0.35 (cohesive) 0.40 (granular)
Minimum Embedment below Finished Grade [5]	Exterior footings in unheated areas: 42 inches Interior footings in heated areas: 12 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch

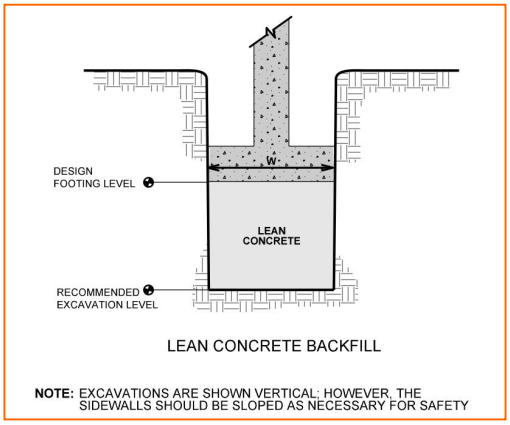
1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork**.
4. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
5. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.

Foundation Construction Considerations

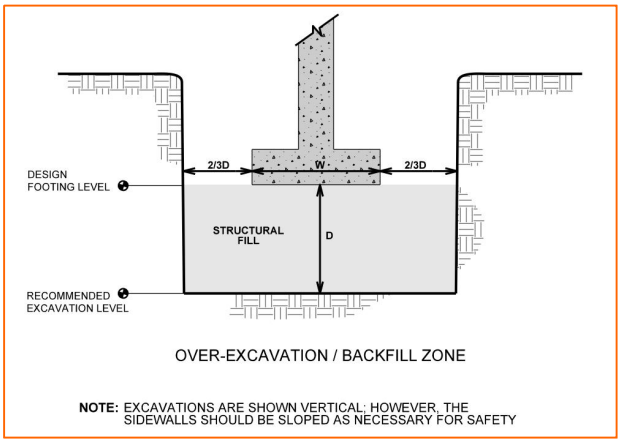
As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Due to the granular nature of the existing site soils at many of the proposed structure locations, the sides of the foundation excavations may not hold a vertical face, requiring them to be laid back to safe angles and the footings to be formed prior to concreting. When this is necessary, and following the removal of the formwork, the resulting excavations should be backfilled following the requirements in **Earthwork**.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



Over-excavation for engineered fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with engineered fill placed as recommended in the **Earthwork** section.



DEEP FOUNDATIONS

Drilled Shaft Design Parameters

Soil design parameters are provided below in the **Drilled Shaft Design Summary** table for the design of drilled shaft foundations. The values presented for allowable side friction and end bearing include a factor of safety.

Drilled Shaft Design Summary [1]				
Approximate Elevation (feet)	Stratigraphy [2]		Allowable Skin Friction (psf) [3,4]	Allowable End Bearing Pressure (psf) [5]
	No.	Material		
970 – 959	2	Fill – Silty to Clayey Sand	100	Ignore
959 – 954	3	Loose Gravel	250	8,000
954 – 939	3	Loose Silty Sand/Sand with Silt	350	13,000
939 – 931	3	Medium Dense Silty Sand	500	23,500

1. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
2. See **Subsurface Profile** in **Geotechnical Characterization** for more details on stratigraphy.
3. Applicable for compressive loading only. Reduce to 2/3 of values shown for uplift loading. Effective weight of shaft can be added to uplift load capacity.
4. Ignore the contribution of skin friction within 5 feet of the ground surface to account for disturbance, soil volume change and frost action.
5. Shafts should extend at least one diameter into the bearing stratum (or to a depth equal to the bell diameter for belled shafts) for end bearing to be considered.

Tensile reinforcement should extend to the bottom of shafts subjected to uplift loading. Buoyant unit weights of the soil and concrete should be used in the calculations below the highest anticipated groundwater elevation.

Drilled shafts should have a minimum (center-to-center) spacing of three diameters. Closer spacing may require a reduction in axial load capacity. Axial capacity reduction can be determined by comparing the allowable axial capacity determined from the sum of individual piles in a group versus the capacity calculated using the perimeter and base of the pile group acting as a unit. The lesser of the two capacities should be used in design.

A minimum shaft diameter of 24 inches should be used. Drilled shafts should have a minimum length of 12 feet to extend through the existing fill materials and should extend into the bearing strata at least one shaft/pile/bell diameter for the allowable end-bearing pressures listed in the above table.

Drilled Shaft Lateral Loading

The following table lists input values for use in LPILE analyses. LPILE estimates values of k_h and E_{50} based on strength; however, non-default values of k_h should be used where provided. Since deflection or a service limit criterion will most likely control lateral capacity design, no safety/resistance factor is included with the parameters.

Stratigraphy [1]			L-Pile Soil Model	S_u (psf) [2]	f [2]	g (pcf) [2,3]	ε_{50} [2]	K (pci) [2]	
Elev.	No.	Material						Static	Cyclic
970-959	2	Fill	Sand (Reese)	---	30°	117	---	100	100
959-954	3	Loose Gravel	Sand (Reese)	---	28°	120	---	40	40
954-939	3	Loose Sand	Sand (Reese)	---	29°	130	---	40	40
939-931	3	Medium Dense Sand	Sand (Reese)	---	32°	130	---	150	150

1. See **Subsurface Profile** in **Geotechnical Characterization** for more details on Stratigraphy.
2. Definition of Terms:
   - S_u: Undrained shear strength
   - f : Internal friction angle,
   - g: Moist unit weight
   - ε_{50}: Non-default E50 strain
   - K: Horizontal modulus of subgrade reaction
3. Buoyant unit weight values should be used below water table.

For the case of a single row of shafts supporting a laterally loaded grade beam, group action for lateral resistance of shafts would need to be considered when spacing is less than three shaft diameters (measured center-to-center). However, spacing closer than 3D (where D is the diameter of the shaft) is not recommended, due to potential for the installation of a new shaft disturbing an adjacent installed shaft, likely resulting in axial capacity reduction.

Pile caps and/or grade beams could be subject to uplift loading due to frost action; thus, perimeter foundation elements beneath unheated areas should extend at least 3.5 feet below the lowest adjacent finished grade for frost protection.

The load capacities provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the shafts/piles should be checked to assure they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of shafts/piles should be evaluated using an appropriate analysis method, and will depend upon the pile's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of shafts/piles may be increased by increasing the diameter and/or length.

Drilled Shaft Construction Considerations

The boring generally encountered granular soils as well as relatively shallow groundwater. The use of temporary steel casing ("dry" method) and/or slurry drilling procedures ("wet" method) should be anticipated at this site during drilled shaft construction to prevent collapse of the sidewalls within sand seams and layers and control groundwater seepage. The drilled shaft contractor and foundation design engineer should be informed of these risks.

Care should be taken to not disturb the sides and bottom of the excavation during construction. The bottom of the shaft excavation should be free of loose material before concrete placement. Concrete should be placed as soon as possible after the foundation excavation is completed, to reduce potential disturbance of the bearing surface. If casing is removed during concrete placement, care should be exercised to maintain concrete inside the casing at a sufficient level to resist earth and hydrostatic pressures present on a casing exterior. Arching of the concrete, loss of seal and other problems can occur during casing removal and result in contamination of the drilled shaft. These conditions should be considered during the design and construction phases. Placement of loose soil backfill should not be permitted around the casing prior to removal.

"Wet" shafts should be constructed by slurry displacement techniques. In this process, the shaft excavation is filled with approved polymer-based slurry to counter-balance the hydraulic forces below the water level and stabilize the wall of the shaft. Concrete would then be placed using a tremie extending to within 6 inches of the shaft base of the slurry-filled excavation. The tremie remains inserted several feet into the fresh concrete as it displaces the slurry upward and until placement is complete. The slurry should have a sand content no greater than 1% at the time concrete placement commences.

Concrete for "dry" drilled shaft construction should have a slump of about 5 to 7 inches. Concrete should be directed into the shaft utilizing a centering chute. Concrete for "wet" shaft construction would require higher slump concrete.

The drilled shaft installation process should be performed under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the shaft installation process including soil/rock and groundwater conditions encountered, consistency with expected conditions, and details of the installed shaft.

Construction Adjacent to Existing Building

Differential settlement between the elevator addition and the existing building is expected to approach the magnitude of the total settlement of the addition. Expansion joints should be provided between the existing building and the proposed addition to accommodate differential movements between the two structures. Underground piping between the two structures should be designed with flexible couplings and utility knockouts in foundation walls should be oversized, so minor deflections in alignment do not result in breakage or distress. Care should be taken during excavation adjacent to existing foundations to avoid disturbing existing foundation bearing soils.

Existing foundations may impose additional load from the building's walls on the foundations for the new addition, if the drilled shafts are constructed within the existing foundations influence zone. The structural capacity of new foundations should be evaluated by a licensed structural engineer, with consideration of increased loading that may occur.

SEISMIC CONSIDERATIONS

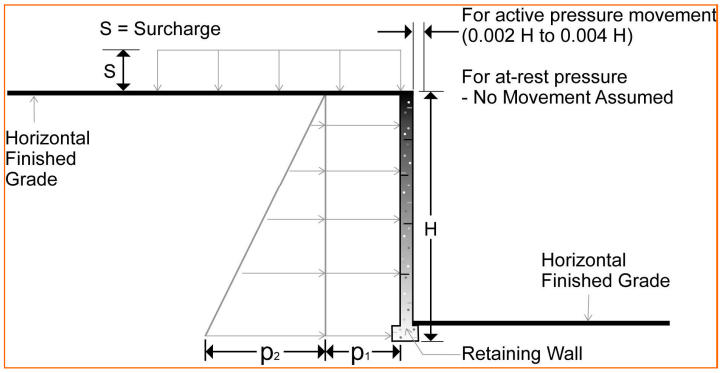
The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Subsurface explorations at this site were extended to a maximum depth of 40 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be

influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The “at-rest” condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



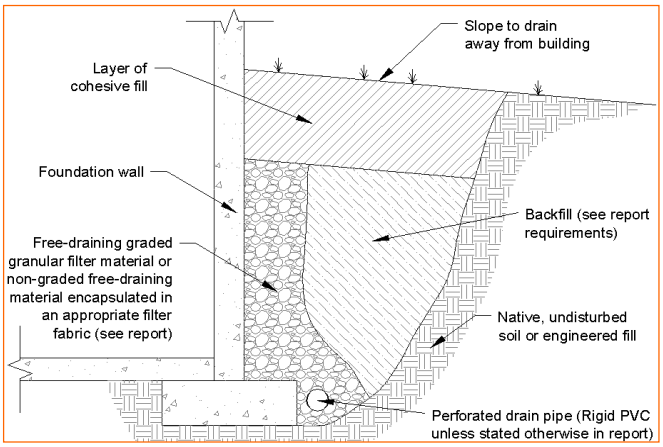
Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	**Coefficient for Backfill Type** [2]	**Surcharge Pressure** [3, 4, 5] **p_1 (psf)**	**Effective Fluid Pressures (psf)** [2, 4, 5]	
			Unsaturated [6]	**Submerged** [6]
Active (Ka)	Granular - 0.31	(0.31)S	(40)H	(80)H
	Fine Grained - 0.41	(0.41)S	(50)H	(85)H
At-Rest (Ko)	Granular - 0.47	0.47)S	(55)H	(90)H
	Fine Grained - 0.58	(0.58)S	(70)H	(95)H
Passive (Kp)	Granular - 3.25	---	(390)H	(250)H
	Fine Grained - 2.46	---	(295)H	(205)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95% of the ASTM D 698 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. To achieve “Unsaturated” conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. “Submerged” conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

FROST CONSIDERATIONS

The soils on this site are generally frost susceptible, and small amounts of water can affect the performance of the slabs on-grade and sidewalks. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill or structural slabs (for instance, structural stoops in front of building doors). Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the buildings and slabs, and toward the site storm drainage system, if present.
- Install drains around the perimeter of the buildings, stoops and below exterior slabs, and connect them to the storm drainage system, if present.
- Grade clayey subgrades, so groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base, slope toward a site drainage system, if present.
- Place NFS fill as backfill beneath slabs critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS fill and other soils.
- Place NFS materials in critical sidewalk areas.

As an alternative to extending NFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS material.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

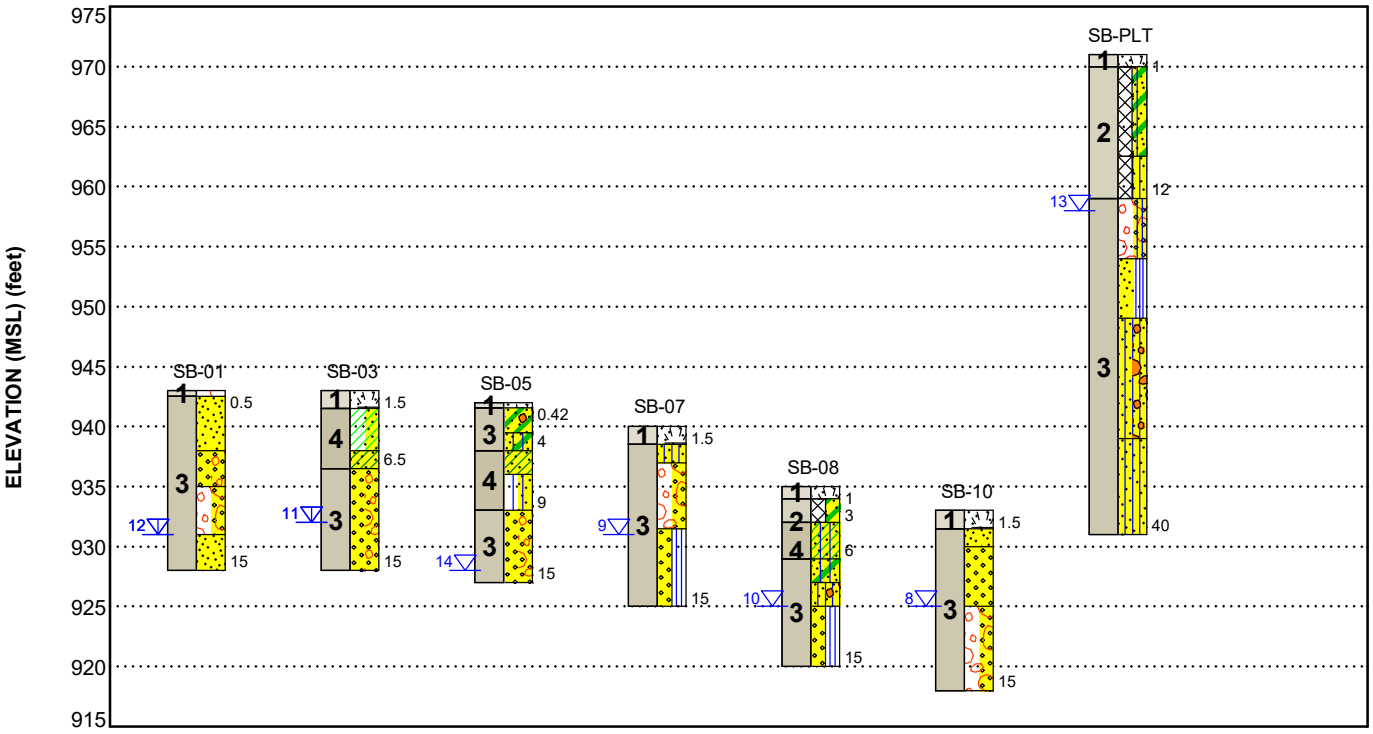
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

GEOMODEL

Plant and Wellfield Improvements ■ Strasburg, OH
Terracon Project No. N6215094



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Surface materials**	Aggregate and/or Topsoil
2	**Existing Fill**	Loose to medium dense, clayey to silty sand
3	**Native Granular Soils**	Loose to dense, poorly to well graded sands, silty to clayey sands and well graded gravel
4	**Native Cohesive Soils**	Medium stiff to very stiff, lean clay and silt

LEGEND

- Aggregate Base Course
- Well-graded Gravel w/sand
- Sandy Lean Clay
- Silt with Sand
- Clayey Sand
- Poorly-graded Sand
- Topsoil
- Clayey Sand with Gravel
- Silty Sand
- Sandy Silty Clay
- Well-graded Sand with Gravel
- Lean Clay with Sand
- Silty Clayey Sand
- Well-graded Sand with Silt
- Silty Sand with Gravel

▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
6	15	Selected Well Locations
1	40	WTP Building

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a recreational, handheld GPS unit (estimated horizontal accuracy of about ±20 feet) and approximate elevations were obtained by interpolation from Google Earth.

Subsurface Exploration Procedures: We advanced the borings with an ATV-mounted rotary drill rig using continuous flight, hollow stem augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

The laboratory testing program included classification of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

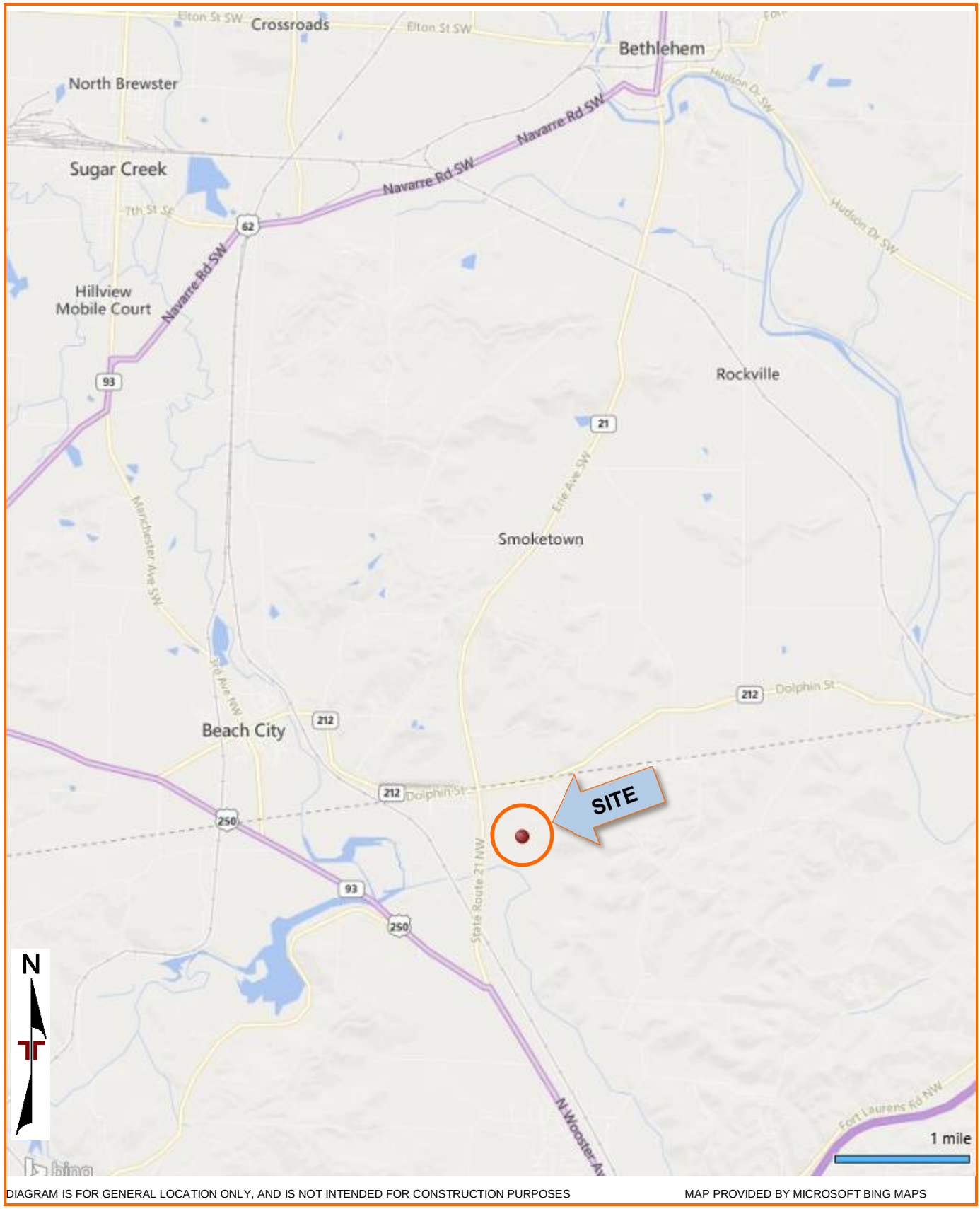


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (SB-01 through SB-10 and SB-PLT)
Atterberg Limits Results
Grain Size Distribution

Note: All attachments are one page unless noted above.

BORING LOG NO. SB-01

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan
Moved 6.0' East
Latitude: 40.6379° Longitude: -81.5500°
Approximate Surface Elev.: 943 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		0.5	942.5+/-								
			AGGREGATE BASE COURSE (6")								
			POORLY GRADED SAND (SP), fine to medium grained, brown, loose to medium dense				17	4-4-2 N=6			
							18	1-1-1 N=2		17.5	NP
		5.0	938+/-	5							
3			**WELL GRADED SAND WITH GRAVEL (SW)**, brown, dense				18	4-8-11 N=19			
		8.0	935+/-								
			WELL GRADED GRAVEL WITH SAND (GW), brown, medium dense				15	7-6-4 N=10			
		12.0	931+/-	10							
			POORLY GRADED SAND (SP), fine to medium grained, brown, loose				4	7-4-1 N=5			
		15.0	928+/-	15							
			Boring Terminated at 15 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

- *12.0' While drilling*
- *12.0' At completion of drilling*
- *Dry cave in at 9.0'*

Terracon
12460 Plaza Dr
Parma, OH

Boring Started: 04-28-2021
Boring Completed: 04-28-2021
Drill Rig: B-57
Driller: D. Hepner
Project No.: N6215094

BORING LOG NO. SB-03

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan

Latitude: 40.6387° Longitude: -81.5478°

Approximate Surface Elev.: 943 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		0									
		TOPSOIL (18")									
		1.5	941.5+/-								
4		**LEAN CLAY WITH SAND (CL)**, brown, medium stiff to stiff				X	18	3-3-2 N=5	0.75 (HP)		
						X	18	2-1-1 N=2	0.25 (HP)	29.8	30-22-8
		5.0	938+/-	5							
		SANDY LEAN CLAY (CL), brown, medium stiff									
		6.5	936.5+/-			X	18	2-6-9 N=15	0.5 (HP)	19.2	
3		**WELL GRADED SAND WITH GRAVEL (SW)**, brown, dense									
		-cobble at 8.5'				X	18	12-12-8 N=20			
				10	▽						
						X	15	6-8-11 N=19			
		15.0	928+/-	15							
		Boring Terminated at 15 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *11.0' While drilling*

▽ *11.0' At completion of drilling*

Terracon
12460 Plaza Dr
Parma, OH

Boring Started: 04-28-2021 | Boring Completed: 04-28-2021

Drill Rig: B-57 | Driller: D. Hepner

Project No.: N6215094

BORING LOG NO. SB-05

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan

Latitude: 40.6396° Longitude: -81.5456°

Approximate Surface Elev.: 942 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		0.4	941.5+/-								
		TOPSOIL (5")									
		CLAYEY SAND WITH GRAVEL (SC), brown, medium dense									
3						X	18	3-4-3 N=7			
		2.5	939.5+/-								
		SILTY CLAYEY SAND (SC-SM), brown, medium dense									
		4.0	938+/-								
		SANDY LEAN CLAY (CL), brown, very stiff				X	18	3-4-3 N=7	2.0 (HP)	14.8	22-15-7
				5							
		6.0	936+/-								
4		**SILT WITH SAND (ML)**, brown, medium stiff				X	18	3-2-2 N=4	0.75 (HP)	27.0	30-23-7
		9.0	933+/-								
		WELL GRADED SAND WITH GRAVEL (SW), brown, medium dense				X	18	2-4-4 N=8	1.0 (HP)		
3				10							
					▽	X	18	13-8-4 N=12			
		15.0	927+/-	15							
		Boring Terminated at 15 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *14.0' While drilling*

Terracon
12460 Plaza Dr
Parma, OH

Boring Started: 04-28-2021 | Boring Completed: 04-28-2021

Drill Rig: B-57 | Driller: D. Hepner

Project No.: N6215094

BORING LOG NO. SB-07

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan

Latitude: 40.6407° Longitude: -81.5443°

Approximate Surface Elev.: 940 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		0.0									
		TOPSOIL (18")									
		1.5	938.5+/-								
		SILTY SAND (SM), brown, loose					16	2-2-2 N=4		9.7	
		3.0	937+/-								
		WELL GRADED GRAVEL WITH SAND (GW), brown, medium dense					16	3-5-5 N=10			
				5							
							16	3-5-8 N=13			
3		8.5	931.5+/-								
		WELL GRADED SAND WITH SILT (SW-SM), brown, loose			▽		18	5-3-3 N=6		15.5	
				10							
							17	2-2-2 N=4			
		15.0	925+/-	15							
		Boring Terminated at 15 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *9.0' While drilling*

▨ *Dry cave in at 8.5'*

Terracon
12460 Plaza Dr
Parma, OH

Boring Started: 04-28-2021 | Boring Completed: 04-28-2021

Drill Rig: B-57 | Driller: D. Hepner

Project No.: N6215094

BORING LOG NO. SB-08

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan

Latitude: 40.6387° Longitude: -81.5427°

Approximate Surface Elev.: 935 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		1.0	934+/-								
		TOPSOIL (12")									
2		3.0	932+/-			X	18	4-4-4 N=8			
		FILL - CLAYEY SAND (SC), brown, medium dense, contains styrofoam fragments									
4		6.0	929+/-	5		X	18	1-1-1 N=2		16.4	26-20-6
		SANDY SILTY CLAY (CL-ML), brown with gray, medium stiff									
		8.0	927+/-			X	16	1-2-1 N=3		9.8	
		SILTY CLAYEY SAND (SC-SM), brown, loose									
		10.0	925+/-			X	0	5-6-5 N=11			
3		**SILTY SAND WITH GRAVEL (SM)**, brown, medium dense		10							
		15.0	920+/-	15		X	18	3-2-4 N=6			
		WELL GRADED SAND WITH SILT (SW-SM), brown, medium dense									
		Boring Terminated at 15 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *10.0' While drilling*

Dry cave in at 8.5'

Terracon
12460 Plaza Dr
Parma, OH

Boring Started: 04-28-2021 | Boring Completed: 04-28-2021

Drill Rig: B-57 | Driller: D. Hepner

Project No.: N6215094

BORING LOG NO. SB-10

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan

Latitude: 40.6365° Longitude: -81.5420°

Approximate Surface Elev.: 933 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		0.0									
		TOPSOIL (18")									
		1.5	931.5+/-								
		POORLY GRADED SAND (SP), fine to medium grained, brown, loose to medium dense					18	2-5-5 N=10		8.7	NP
		3.0	930+/-								
		WELL GRADED SAND (SW), brown, medium dense					17	2-2-2 N=4		5.9	
				5							
							18	2-3-5 N=8			
		8.0	925+/-								
3		**WELL GRADED GRAVEL WITH SAND (GW)**, brown, medium dense					18	5-7-8 N=15			
				10							
							18	5-7-7 N=14			
		15.0	918+/-	15							
		Boring Terminated at 15 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *8.0' While drilling*

Dry cave in at 7.0'

Terracon
12460 Plaza Dr
Parma, OH

Boring Started: 04-28-2021 | Boring Completed: 04-28-2021

Drill Rig: B-57 | Driller: D. Hepner

Project No.: N6215094

BORING LOG NO. SB-PLT

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan

Latitude: 40.6428° Longitude: -81.5387°

Approximate Surface Elev.: 971 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
1		1.0	970+/-								
2			**FILL - SILTY CLAYEY SAND**, brown, loose to medium dense			X	18	2-2-4 N=6			
			-brownish gray, slightly organic @ 3.5'	5		X	18	2-2-2 N=4		17.0	22-15-7
						X	18	1-1-2 N=3		9.1	20-14-6
		8.5	962.5+/-								
			FILL - SILTY SAND, brown, loose, contains coal fragments	10		X	18	2-2-3 N=5		18.5	
		12.0	959+/-								
3			**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, brown, loose		▽						
				15		X	18	2-2-1 N=3		10.5	
		17.0	954+/-								
			POORLY GRADED SAND WITH SILT (SP-SM), reddish brown, loose	20		X	18	3-3-2 N=5		23.8	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *13.0' While drilling*

Terracon
12460 Plaza Dr
Parma, OH

Boring Started: 04-29-2021 | Boring Completed: 04-29-2021

Drill Rig: B-57 | Driller: D. Hepner

Project No.: N6215094

BORING LOG NO. SB-PLT

PROJECT: Plant and Wellfield Improvements

CLIENT: Burgess & Niple Inc
Painesville, OH

SITE: 9649 Dolphin Street SW
Strasburg, OH

LOCATION See Exploration Plan

Latitude: 40.6428° Longitude: -81.5387°

Approximate Surface Elev.: 971 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
3		22.0	949+/-								
				25			7	3-2-3 N=5			
								3-2-3 N=5			
		32.0	939+/-	30							
				35			15	2-6-9 N=15			
		40.0	931+/-	40			11	5-6-6 N=12			

POORLY GRADED SAND WITH SILT (SP-SM), reddish brown, loose *(continued)*

SILTY SAND WITH GRAVEL (SM), brown, loose

SILTY SAND (SM), brown, medium dense

Boring Terminated at 40 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations interpreted from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *13.0' While drilling*

Terracon
12460 Plaza Dr
Parma, OH

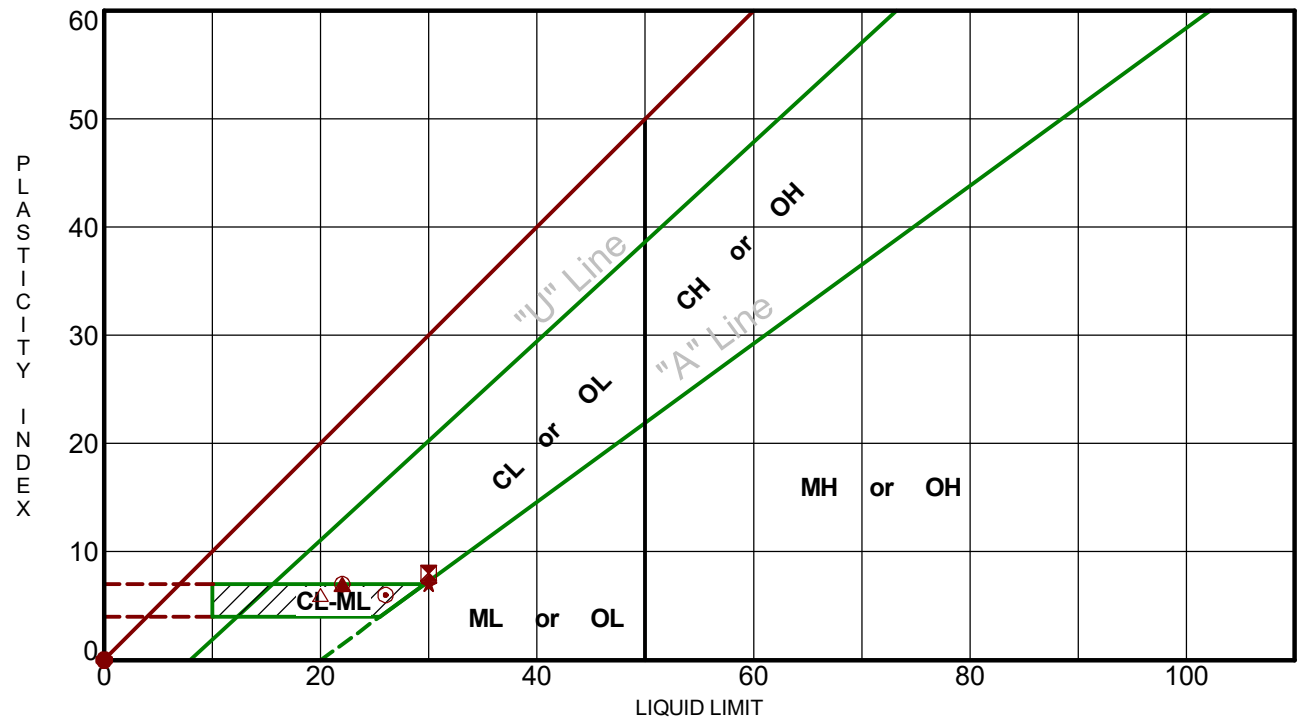
Boring Started: 04-29-2021 | Boring Completed: 04-29-2021

Drill Rig: B-57 | Driller: D. Hepner

Project No.: N6215094

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	SB-01	3.5 - 5	NP	NP	NP		SP	POORLY GRADED SAND
⊠	SB-03	3.5 - 5	30	22	8	80.6	CL	LEAN CLAY with SAND
▲	SB-05	3.5 - 5	22	15	7	45.8	SC-SM	SILTY, CLAYEY SAND
★	SB-05	6 - 7.5	30	23	7	82.2	ML	SILT with SAND
⊙	SB-08	3.5 - 5	26	20	6	54.5	CL-ML	SANDY SILTY CLAY
✿	SB-10	1 - 2.5	NP	NP	NP		SP	POORLY GRADED SAND
○	SB-PLT	3.5 - 5	22	15	7		SC-SM	SILTY, CLAYEY SAND
△	SB-PLT	6 - 7.5	20	14	6	40.2	SC-SM	SILTY, CLAYEY SAND

PROJECT: Plant and Wellfield Improvements

PROJECT NUMBER: N6215094

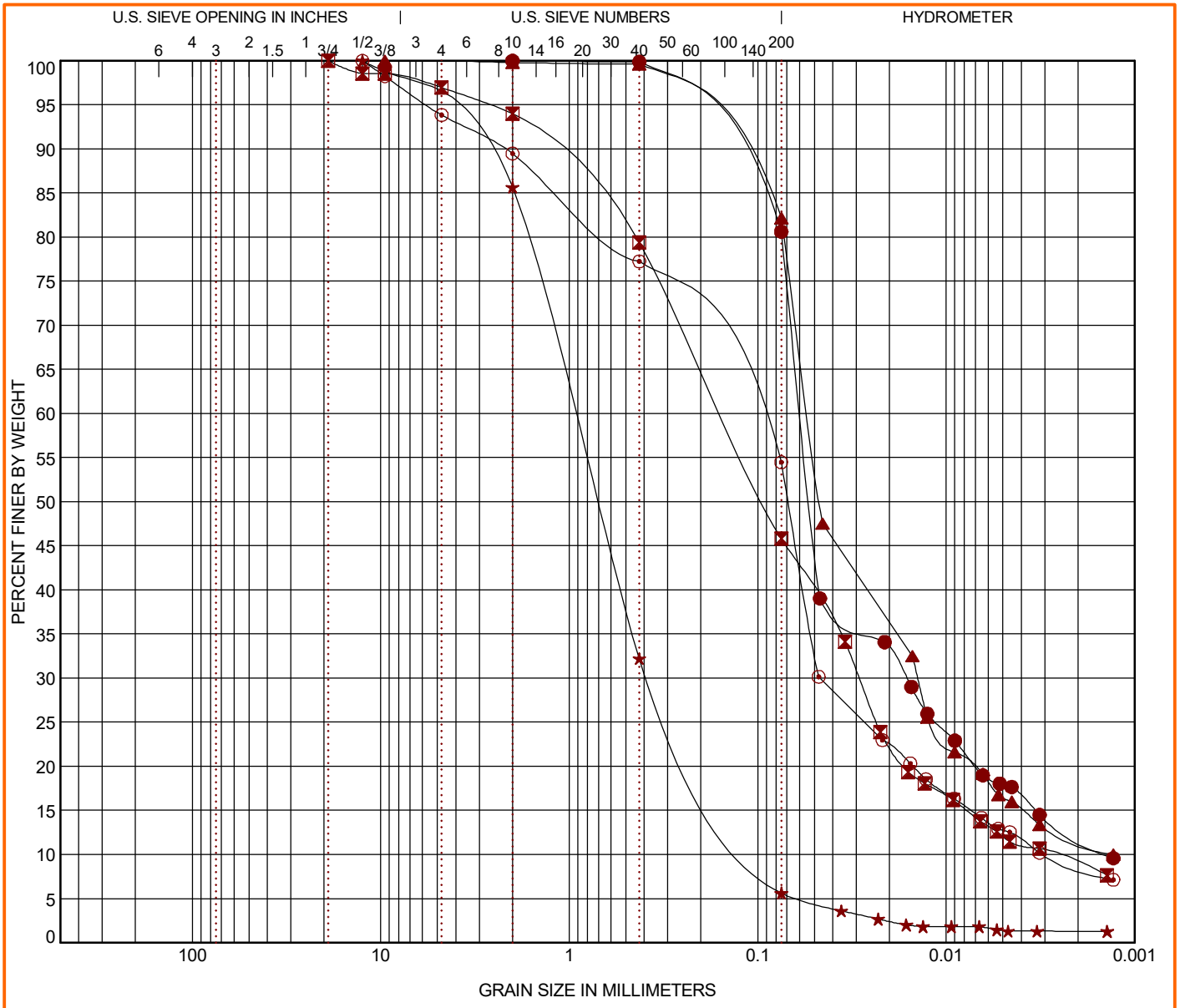
SITE: 9649 Dolphin Street SW
Strasburg, OH

Terracon
12460 Plaza Dr
Parma, OH

CLIENT: Burgess & Niple Inc
Painesville, OH

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	SB-03	3.5 - 5	LEAN CLAY with SAND (CL)	29.8	30	22	8	3.19	42.28
⊠	SB-05	3.5 - 5	SILTY, CLAYEY SAND (SC-SM)	14.8	22	15	7	2.01	58.60
▲	SB-05	6 - 7.5	SILT with SAND (ML)	27.0	30	23	7	2.80	41.32
★	SB-07	8.5 - 10	WELL GRADED SAND with SILT (SW-SM)	15.5				1.43	9.53
⊙	SB-08	3.5 - 5	SANDY SILTY CLAY (CL-ML)	16.4	26	20	6	6.29	37.65

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	SB-03	3.5 - 5	2	0.059	0.016	0.001	0.0	0.0	19.4	62.7		17.9
⊠	SB-05	3.5 - 5	19	0.156	0.029	0.003	0.0	3.0	51.1	33.8		12.0
▲	SB-05	6 - 7.5	9.5	0.054	0.014	0.001	0.0	0.1	17.7	65.7		16.5
★	SB-07	8.5 - 10	12.5	0.951	0.368	0.1	0.0	7.0	87.3	4.2		1.4
⊙	SB-08	3.5 - 5	12.5	0.114	0.047	0.003	0.0	6.2	39.4	41.7		12.8

PROJECT: Plant and Wellfield Improvements

PROJECT NUMBER: N6215094

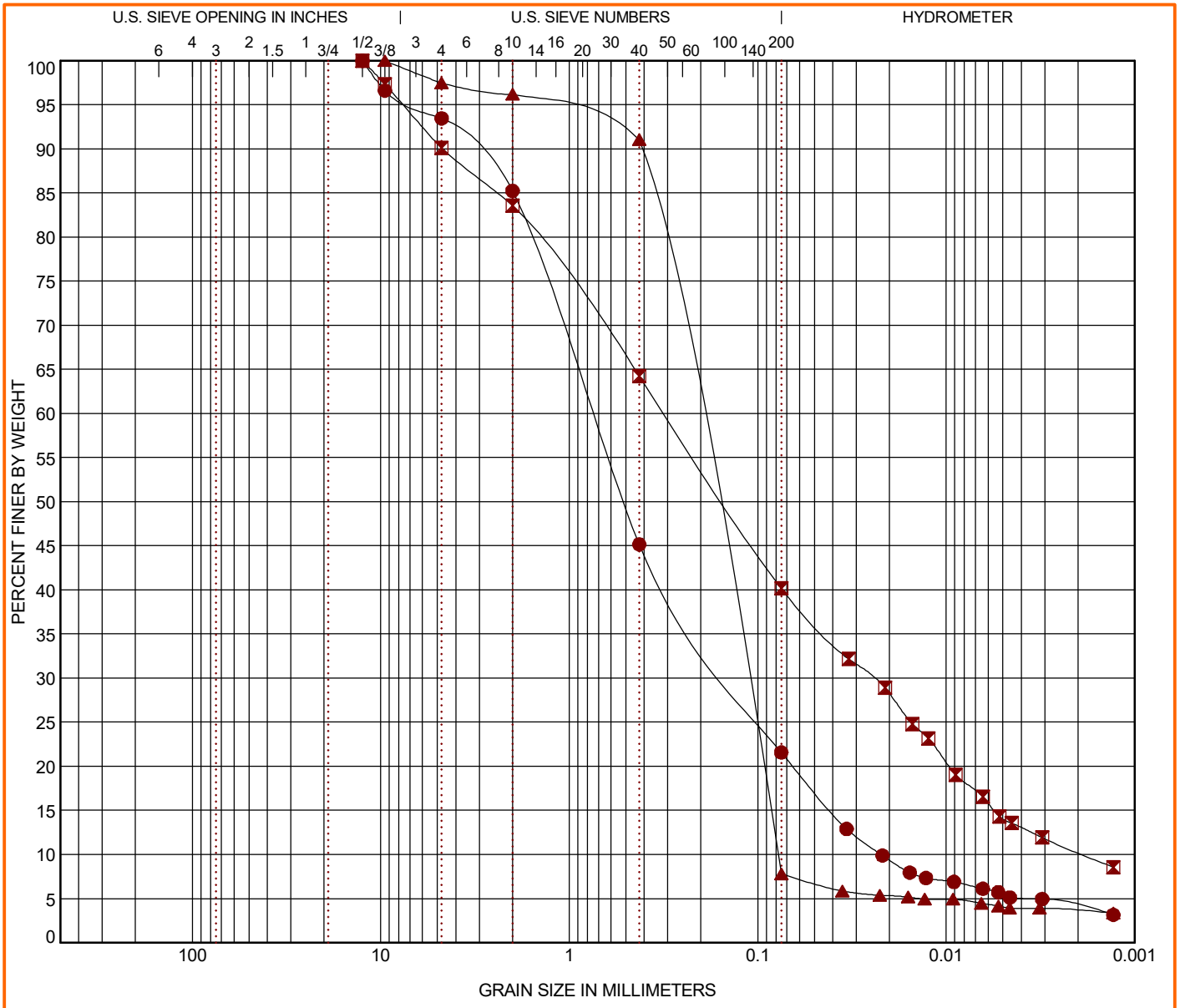
SITE: 9649 Dolphin Street SW
Strasburg, OH

Terracon
12460 Plaza Dr
Parma, OH

CLIENT: Burgess & Niple Inc
Painesville, OH

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	SB-08	6 - 7.5	SILTY, CLAYEY SAND (SC-SM)	9.8				1.16	33.98
⊠	SB-PLT	6 - 7.5	SILTY, CLAYEY SAND (SC-SM)	9.1	20	14	6	1.02	165.79
▲	SB-PLT	18.5 - 20	POORLY GRADED SAND with SILT (SP-SM)	23.8				0.81	2.83

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	SB-08	6 - 7.5	12.5	0.754	0.139	0.022	0.0	6.5	71.9	16.1		5.5
⊠	SB-PLT	6 - 7.5	12.5	0.313	0.025	0.002	0.0	9.9	50.0	26.1		14.1
▲	SB-PLT	18.5 - 20	9.5	0.223	0.119	0.079	0.0	2.5	89.7	3.8		4.0

PROJECT: Plant and Wellfield Improvements

PROJECT NUMBER: N6215094

SITE: 9649 Dolphin Street SW
Strasburg, OH

Terracon
12460 Plaza Dr
Parma, OH

CLIENT: Burgess & Niple Inc
Painesville, OH

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS
Plant and Wellfield Improvements ■ Strasburg, OH
Terracon Project No. N6215094

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Split Spoon	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ³ 4 and 1 £ Cc £ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ³ 6 and 1 £ Cc £ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A”		CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K, L, M]
			PI plots below “A” line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ³ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ³ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ³ 30% plus No. 200 predominantly sand, add “sandy” to group name.

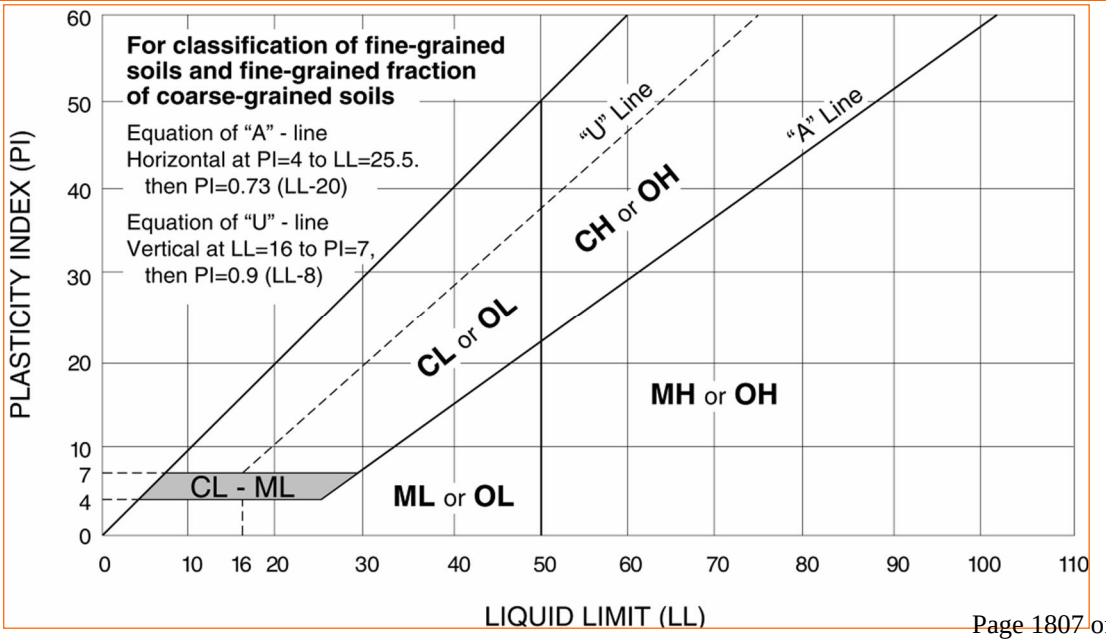
[M] If soil contains ³ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ³ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.



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APPENDIX II - LEAD AND ASBESTOS SURVEY RESULTS

EA GROUP
Environmental Analysis and Management

October 19, 2019

Mr. Carl Seifried
Burgess & Niple
100 West Erie Street
Painesville, Ohio 44077

RE: **Suspect Asbestos-Containing Materials Sampling & Analysis and Paint Sampling for Lead Content**
City of Canton Sugar Creek Water Treatment Plant
9520 Dolphin Street SW, Strasburg, Ohio
OH43702

Description of Work

EA Group, Mentor, Ohio was contracted by Burgess & Niple to conduct sampling and analysis of designated suspect asbestos-containing materials (ACMs) and of paints on representative surfaces to determine lead content, in designated areas at the City of Canton Sugar Creek Water Treatment Plant facilities in Strasburg, Ohio. Sampling was performed on September 18 and 25, 2020 by EA Group representative Corey Falatic.

Asbestos Sampling

EA Group's licensed Asbestos Hazard Evaluation Specialist Corey Falatic, ES36126, secured samples of the designated suspect ACMs, in the designated areas, on September 18 and 25, 2020. Homogeneous Groups of suspect ACM are identified on the *Asbestos Inspection Data Sheet* forms in Appendix A, which includes schematics of the general sampling locations. Classification of any positively identified ACM has been made per National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations, with additional notations for potential Occupational Safety and Health Administration (OSHA) compliance purposes, if warranted.

Objective and Limitations of the Inspection

The objective of this project was to sample and analyze designated suspect ACM, limited to specific materials designated by the Client at the City of Canton Sugar Creek Water Treatment Plant facilities in Strasburg, Ohio, pursuant to NESHAP and OSHA regulations. The work did not constitute a "survey" or "inspection" for the presence of suspect ACM, and sampling was *strictly limited* to the designated suspect materials in the designated areas, all as identified by the on-site Burgess & Niple representative. No other materials or areas were assessed.

Asbestos Analysis

The bulk samples were analyzed by polarized light microscopy for asbestos content at or through the Laboratory Division of EA Group, which is accredited by the National Institute of Standards and Technology – National Voluntary Laboratory Accreditation Program. The United States Environmental Protection Agency requires all materials containing greater than one percent asbestos

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by weight to be considered asbestos-containing materials. Composite or layered analyses were performed, depending on the nature of a material. If an initial analysis indicated less than 10% asbestos, additional analysis (point-counting) was conducted. In all cases that at least one sample from a homogeneous group [Group] was determined to be ACM, the Group as a whole is considered ACM regardless of the results for any other samples from that Group. Analytical results are provided in Appendix D.

Results of Asbestos Analysis

The materials that were sampled as suspect and were determined to contain regulated amounts of asbestos are identified in Table 1, which also includes materials determined to be non-ACM (no asbestos detected). Results are also expressed on the table in Appendix B, which references the original list provided by Burgess & Niple. Sample locations are shown on provided drawings in Appendix B. Please note that inconsistencies between the original listing and drawings were corrected.

Any activities that involve the handling or disturbance of ACM should be carried out by a licensed abatement contractor or other appropriately trained personnel in accordance with all applicable regulations.

Paint Chip Sampling of Suspect Lead-Based Paint

Representative paint samples were secured from 66 designated components, as identified by the on-site Burgess & Niple representative, and were subsequently analyzed in accordance with U.S. EPA SW846 Method 6010B to determine the concentration of lead in each sample. The type and location of the components, along with the result of the analyses, are provided in the attached Table 2. Analytical results are detailed in the laboratory report in Appendix D.

The U.S. EPA defines paint that contains more than 5000 milligrams per kilogram (mg/kg) [equivalent to parts per million (ppm)] of lead as *lead-based paint*. The Consumer Product Safety Act "Ban of Lead-containing Paint and Certain Consumer Products Bearing Lead-Based Paint" defines paint that contains more than 600 mg/kg as lead-containing paint. OSHA regulates potential employee exposure to lead, regardless of the concentration in paint.

As shown in Table 2, and detailed in the laboratory report in Appendix B, 41 of the samples contained detectable (quantifiable) concentrations of lead, five at concentrations representative of LBP and 15 at concentrations consistent with lead-containing paint. Any workers or contractors who may disturb

these specific paints should be provided a copy of these results so they are able to follow required OSHA regulations

Any waste debris associated with the paints that contain more than 100 mg/kg of total lead may constitute “hazardous waste” due to lead toxicity, particularly if paint chip waste is generated. Depending on the type of waste generated, sampling of wastes associated with these specific paints for analysis for lead by toxicity characteristic leaching procedure (TCLP) protocol may be required.

Results for paint sampling are also expressed on the table in Appendix C, which references the original list provided by Burgess & Niple. Sample locations are shown on provided drawings in Appendix C. Please note that inconsistencies between the original listing and drawings were corrected.

If you have any questions or concerns regarding the above information, please contact the undersigned. Thank you for consulting EA Group.

Sincerely,

EA Group

Timothy S. Bowen,
Vice President/Technical Director

Corey Falatic,
ES36126

Table 1 Summary of Results - City of Canton Sugar Creek Water Treatment Plant, Strasburg, Ohio

Group	ID #	MATERIAL DESCRIPTION	Material Type	RESULT
A	OH43702-RS-WS1	Window Sealant; Gray	M/NF2	0
A	OH43702-RS-WS2	Window Sealant; Gray	M/NF2	0
B	OH43702-ML-CL1	Drywall Ceiling	M/NF2	0
B	OH43702-OO-CL2	Drywall Ceiling	M/NF2	0
B	OH43702-CR-CL3	Drywall Ceiling	M/NF2	0
C	OH43702-ML-CL5	Drywall Ceiling; Texture	M/NF2	0
C	OH43702-MT-CL6	Drywall Ceiling; Texture	M/NF2	0
C	OH43702-MT-CL7	Drywall Ceiling; Texture	M/NF2	0
D	---	Pipe Insulation; Fiberglass	N/S	0
E	OH43702-MR-PL1	6" Pipe Insulation	T	**[+]**
E	OH43702-MR-PL2	6" Pipe Insulation	T	**[+]**
E	OH43702-MR-PL3	6" Pipe Insulation	T	**[+]**
F	OH43702-SR-WS1	Window Sealant; Gray	M/NF2	**[+],**B
F	OH43702-SR-WS2	Window Sealant; Gray	M/NF2	**[+],**B
G	OH43702-MR-WS1	Window Sealant; Beige	M/NF2	**[+],**B
G	OH43702-MR-WS2	Window Sealant; Beige	M/NF2	**[+],**B
H	OH43702-MR-DS1	Door Sealant; Gray	M/NF2	0
H	OH43702-MR-DS2	Door Sealant; Gray	M/NF2	0
I	OH43702-EL-DS1	Door Sealant; Dark Gray	M/NF2	**[+],**B
I	OH43702-EL-DS2	Door Sealant; Dark Gray	M/NF2	**[+],**B
J	OH43702-EL-WS1	Window Sealant; Light Gray	M/NF2	0
J	OH43702-EL-WS2	Window Sealant; Light Gray	M/NF2	0
K	OH43702-LL-DS1	Door Sealant; Light Gray	M/NF2	0
K	OH43702-LL-DS2	Door Sealant; Light Gray	M/NF2	0
L	OH43702-MG-DS1	Door Sealant; Dark Gray	M/NF2	0
L	OH43702-MG-DS2	Door Sealant; Dark Gray	M/NF2	0
M	OH43702-CL-WS1	Window Sealant; Gray	M/NF2	0
M	OH43702-CL-WS2	Window Sealant; Gray	M/NF2	0
N	OH43702-CL-DS1	Door Sealant; Brown	M/NF2	0
N	OH43702-CL-DS4	Door Sealant; Brown	M/NF2	0
O	OH43702-CL-DS2	Door Sealant; Gray	M/NF2	0
O	OH43702-CL-DS3	Door Sealant; Gray	M/NF2	0
P	OH43702-FL-DS1	Door Sealant; Gray	M/NF2	0
P	OH43702-FL-DS2	Door Sealant; Gray	M/NF2	0
Q	OH43702-OG-DS1	Door Sealant; Gray	M/NF2	0
Q	OH43702-OG-DS2	Door Sealant; Gray	M/NF2	0
R	OH43702-OG-DS3	Door Sealant; Gray	M/NF2	0
R	OH43702-OG-DS4	Door Sealant; Gray	M/NF2	0
S	OH43702-OG-WS1	Window Sealant; Gray	M/NF2	0
S	OH43702-OG-WS2	Window Sealant; Gray	M/NF2	0

Table 1 Summary of Results - City of Canton Sugar Creek Water Treatment Plant, Strasburg, Ohio

Group	ID #	MATERIAL DESCRIPTION	Material Type	RESULT
T	OH43702-FR2-WS1	Window Sealant; Black	M/NF2	0
T	OH43702-FR2-WS2	Window Sealant; Black	M/NF2	0
U	OH43702-FR2-WS3	Window Sealant; Black	M/NF2	0
U	OH43702-FR2-WS4	Window Sealant; Black	M/NF2	0
V	OH43702-GB-A1	Glass Block Window Sealant; Gray	M/NF2	**[+],**B
V	OH43702-GB-A2	Glass Block Window Sealant; Gray	M/NF2	**[+],**B
W	OH43702-GB-A3	Glass Block Mortar; Beige	M/NF2	**[+],**B
W	OH43702-GB-A4	Glass Block Mortar; Beige	M/NF2	**[+],**B
X	OH43702-GN-LS1	Louver Sealant; Gray	M/NF2	0
X	OH43702-GN-LS2	Louver Sealant; Gray	M/NF2	0
Y	OH43702-GN-DS1	Door Sealant; Gray	M/NF2	0
Y	OH43702-GN-DS2	Door Sealant; Gray	M/NF2	0
Z	OH43702-AW-R1	Rolled Roofing Core	M/NF1	0
Z	OH43702-AW-R4	Rolled Roofing Core	M/NF1	0
AA	OH43702-AW-R2	Roof Flashing	M/NF1	0
AA	OH43702-AW-R3	Roof Flashing	M/NF1	0
AB	OH43702-AW-B1	Window Sealant; Gray	M/NF2	0
AB	OH43702-AW-B2	Window Sealant; Gray	M/NF2	0
AC	OH43702-AW-DS1	Door Sealant; Gray	M/NF2	0
AC	OH43702-AW-DS2	Door Sealant; Gray	M/NF2	0
AD	OH43702-AE-B1	Window Sealant; Gray	M/NF2	0
AD	OH43702-AE-B2	Window Sealant; Gray	M/NF2	0
AE	OH43702-AE-DS1	Door Sealant; Gray	M/NF2	0
AE	OH43702-AE-DS2	Door Sealant; Gray	M/NF2	0

Group = Homogeneous Group identification

Material Type: S = Surfacing
T = Thermal System Insulation
M = Miscellaneous
NF1 = Non-Friable Category I
NF2 = Non-Friable Category II
N/S = material not suspect

Result: 0 = non-ACM
[+] = ACM
B = verified by layering & point-counting

Table 2. Summary of Paint Chip Sample Analysis for Lead
Burgess & Niple
City of Canton Sugar Creek Water Treatment Plant, Strasburg, Ohio

September 18 & 25, 2020 Sampling

Sample ID	Location	Component	Color	Lead Content
OH43702- W4- P4	Well Field; Well #4	Pump Casing; Metal	Gray	310
OH43702- W4- P5	Well Field; Well #4	Discharge Hatch; Metal	Green	2,400 †
OH43702- W4- P6	Well Field; Well #4	Motor Housing; Metal	Gray	10,400 ‡
OH43702- W2- P1	Well Field; Well #2	Pump Casing; Metal	Gray	29,400 ‡
OH43702- W2- P2	Well Field; Well #2	Discharge Hatch; Metal	Green	390
OH43702- W2- P3	Well Field; Well #2	Motor Housing; Metal	Gray	160
OH43702- W2- P7	Well Field; Well #2	I-Beam; Metal	Gray/Blue	2,040 †
OH43702- W9- P8	Well Field; Well #9	Pump Casing; Metal	Green	22,000 ‡
OH43702- W9- P9	Well Field; Well #9	Discharge Pipe; Metal	Green	226
OH43702- W9- P10	Well Field; Well #9	Motor Housing; Metal	Gray	200
OH43702- W9- P11	Well Field; Well #9	Electrical Panel Door; Metal	Gray	< 61
OH43702- W9- P12	Well Field; Well #9	Electrical Panel Door; Metal	Gray	152
OH43702- LL- P1	Filter Gallery; Lower Level	Fltr#2 Raw Header Pipe; Metal	Blue	< 25
OH43702- LL- P2	Filter Gallery; Lower Level	Fltr#2 Backwash Header; Metal	Blue	< 25
OH43702- LL- P3	Filter Gallery; Lower Level	Fltr#2 W Header Pipe; Metal	Beige	< 25
OH43702- LL- P4	Filter Gallery; Lower Level	Fltr#2 F-T-W Pipe; Metal	Blue	< 25
OH43702- LL- P5	Filter Gallery; Lower Level	Fltr#6 Raw Header Pipe; Metal	Blue	< 25
OH43702- LL- P6	Filter Gallery; Lower Level	Fltr#6 Backwash Header; Metal	Blue	< 25
OH43702- LL- P7	Filter Gallery; Lower Level	Fltr#6 W Header Pipe; Metal	Blue	< 25
OH43702- LL- P8	Filter Gallery; Lower Level	Fltr#4/6 F-T-W Pipe; Metal	Blue	< 25
OH43702- LL- P9	Filter Gallery; Lower Level	Fltr#6 W Header Pipe; Metal	Beige	< 96
OH43702- PG- P5	Main Building; 1st Floor	Fan Housing; Metal	Gray	404
OH43702- PG- P6	Main Building; 1st Floor	Piping; Metal	Blue	1,550 †
OH43702- PG- P7	Main Building; 1st Floor	Piping; Metal	Blue	876 †
OH43702- PG- P8	Main Building; 1st Floor	Piping; Metal	Blue	< 25
OH43702- PG- P9	Main Building; 1st Floor	Piping; Metal	Blue	1,540 †
OH43702- PG- P10	Main Building; 1st Floor	Piping; Metal	Blue	< 25
OH43702- FR2- P1	Filter Room; Old North	Handrail; Metal	Light Green	< 68
OH43702- FR2- P2	Filter Room; New South	Handrail; Metal	Light Green	350
OH43702- ER- P1	Electrical Room; 1st Floor	MCC Cabinet; Metal	Gray	360
OH43702- ER- P2	Screen Building; 1st Floor	Main Pwr Panel East Side; Metal	Gray	1,000 †
OH43702- ER- P3	Screen Building; 1st Floor	Main Pwr Panel West Side; Metal	Gray	< 96
OH43702- ER- P4	Screen Building; 1st Floor	Ductwork, Metal	Beige	< 110
OH43702- AW- P1	Aerator Building; West	Main Header Pipe; Metal	Black	210
OH43702- AW- P2	Aerator Building; West	Pipe Valve; Metal	Black/Gray	58
OH43702- AE- P1	Aerator Building; East	Main Header Pipe; Metal	Black/Gray	1,100 †
OH43702- AE- P2	Aerator Building; East	Pipe Valve; Metal	Black/Gray	< 71
OH43702- P2- P1	High Service Pump Room	Pump #2; Motor Housing; Metal	Dark Gray	140
OH43702- P2- P2	High Service Pump Room	Pump #2; Casing Elbow; Metal	Green	< 110

Table 2. Summary of Paint Chip Sample Analysis for Lead
Burgess & Niple
City of Canton Sugar Creek Water Treatment Plant, Strasburg, Ohio

September 18 & 25, 2020 Sampling

Sample ID	Location	Component	Color	Lead Content
OH43702- P2- P3	High Service Pump Room	Pump #2; Cone Valve; Metal	Blue	410
OH43702- P2- P4	High Service Pump Room	Pump #2; Floor Elbow; Metal	Blue	140
OH43702- P3- P5	High Service Pump Room	Pump #3; Pump Housing; Metal	Dark Gray	44
OH43702- P3- P6	High Service Pump Room	Pump #3; Casing Elbow; Metal	Green	89
OH43702- P3- P7	High Service Pump Room	Pump #3; Cone Valve; Metal	Blue	2,200 †
OH43702- P3- P8	High Service Pump Room	Pump #3; Floor Elbow; Metal	Blue	41.5
OH43702- P4- P9	High Service Pump Room	Pump #4; Motor Housing; Metal	Dark Gray	< 64
OH43702- P4- P10	High Service Pump Room	Pump #4; Cone Valve; Metal	Green	1,200 †
OH43702- P4- P11	High Service Pump Room	Pump #4; Floor Elbow; Metal	Blue	67.8
OH43702- MP- P12	High Service Pump Room	Make Up Pump Motor; Metal	Green	< 25
OH43702- MP- P13	High Service Pump Room	Make Up Pump Casing; Metal	Green	3,010 †
OH43702- ST- P14	High Service Pump Room	Spiral Stairs Handrail; Metal	Light Green	11,400 ‡
OH43702- ST- P15	High Service Pump Room	Spiral Stairs Treads; Metal	Light Green	4,900 †
OH43702- SC- P17	High Service Pump Room	Bldg Column - North; Steel	Beige	1,410 †
OH43702- SC- P18	High Service Pump Room	Bldg Column - South; Steel	Beige	1,660 †
OH43702- DR- P19	High Service Pump Room	Electrical Rm Door Frame; Metal	Gray	200
OH43702- DR- P20	High Service Pump Room	Electrical Rm Door; Metal	Gray	1,700 †
OH43702- CL- P1	Chlorination Room	Door Frame; Metal	Gray	< 25
OH43702- CL- P2	Chlorination Room	Monorail Floor Beam; Metal	Gray	5,420 ‡
OH43702- FL- P1	Fluoridation Room	Safety Shower Pipe; Metal	Blue	< 25
OH43702- FL- P2	Fluoridation Room	Sump Pump Base Plate; Metal	Gray	< 28
OH43702- FL- P3	Fluoridation Room	Handrail; Metal	Gray	< 25
OH43702- OO- P1	Main Building; 2nd Floor	Wall Partition; Metal	Light Brown	< 61
OH43702- CR- P2	Main Building; 2nd Floor	Wall Partition; Metal	Light Brown	370
OH43702- CR- P3	Main Building; 2nd Floor	Door To Lobby; Metal	Gray	< 25
OH43702- CR- P4	Main Building; 2nd Floor	Door Frame To Lobby; Metal	Gray	1,140 †
OH43702- OG- P1	Filter Gallery; 2nd Floor	Skylight Frame; Metal	White	114

Results expressed in milligrams per kilogram (mg/kg).
‡ = Lead-based paint as defined by U.S. EPA (>5000 mg/kg)
† = Lead-containing paint as defined by Consumer Product Safety Act (>600 mg/kg)

[OSHA regulates potential exposure to any detectable level of lead]

EA GROUP
Environmental Analysis and Management

APPENDIX A

Asbestos Inspection Data Sheets

ASBESTOS INSPECTION DATA SHEET KEY

Client and Project Information provided by either Work Order or Scope of Work

Building - Name or address of building.

Functional Space - A room, group of rooms, or homogeneous area designated by the inspector to prepare management plans, design abatement projects, or conduct response actions.

Group No. - An arbitrary number/letter assigned to each homogeneous material (material that is uniform in color and texture, serves the same function, and was installed at the same time) encountered during sampling.

ID # - A sample number assigned by the inspector which begins with the work order number (OH XXXXX) at the top of the column and then a unique sample number for each sample.

Material Description - Distinguishing characteristics that may include system type, function, size, color, shape etc.

Location - Location of homogeneous material being sampled or occurrence of homogeneous material.

Quantity - Defined as linear footage (LF), square footage (SF), or number of fittings or miscellaneous items, each (EA)

Material Type - Abbreviations provided on the form as:

S -	Surfacing Material (troweled or sprayed-on)	NF1 -	Non-friable Category I
T -	Thermal System Insulation	NF2 -	Non-friable Category II
M -	Miscellaneous		

Material Condition

ND - No Damage. The material is in visibly good condition with no apparent damage.

D - Damage. Material that has "Damage" is defined as damage to less than 10% of the entire homogeneous group or less than 25% of a localized section of the homogeneous group.

SD - Significant Damage. Material that is "Significantly Damaged" is defined as damage to greater than 10% of the entire homogeneous group or greater than 25% of a localized section of the homogeneous group.

Cause of Damage -

P -	Physical. Vandalism or accidental damage	D -	Deterioration. Deterioration from age
W -	Water. Water damage	Other -	Additional influences that may cause damage

Present Disturbance Factors - Visible, Accessible, Air Movement, Activity, and Friable

Visible - Can it be seen; Yes or No

Accessible - Yes - The material is accessible to both the occupants of the building and custodial and maintenance personnel.
No - The material is not easily accessible to people; i.e., crawl spaces, pipe tunnels, pipe chases, etc.

Air Movement - Low - No air flow/plenum; air flow not recognizable to human touch.
Medium - Air flow/plenum present; noticeable air flow; recognizable to human touch.
High - Air flow/plenum/air handling unit/fan present; steady to gusty air flow; air flow obvious to human touch.

Activity - Low - No traffic/vibrations.
Medium - Moderate traffic and/or vibration.
High - High traffic and/or continuous vibration.

Friable - A material is considered friable if, when dry, it may be crumbled, pulverized, or reduced to powder by hand pressure.

Present Potential for Damage - Low Potential for Damage - Accessibility, Influence for Vibration and Air Erosion must be no, low or insignificant.
Potential for Damage - Accessible with any combination of low or medium ratings in the Influence for Vibration and Air Erosion categories
Potential for Significant Damage - Accessible with any combination with a high rating in Influence of Vibration and Air Erosion categories.

Hazard Assessment - Abbreviations provided on the form: PD = Potential for Damage; PSD = Potential for Significant Damage; 0 and Alphabetical abbreviations will be provided during reporting.

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Main Building
Project: Pre-Renovation Asbestos Survey		Functional Space: 2nd Floor

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Rear Stairwell	A	OH43702-RS-WS1	Window Sealant; Gray					0	
	A	OH43702-RS-WS2	Window Sealant; Gray					0	
Lobby Ceiling	B	OH43702-ML-CL1	Drywall Ceiling					0	
Operator Office	B	OH43702-OO-CL2	Drywall Ceiling					0	
Control Room	B	OH43702-CR-CL3	Drywall Ceiling					0	
Men's Locker Room	C	OH43702-ML-CL5	Drywall Ceiling; Texture					0	
Men's Toilet Room	C	OH43702-MT-CL6	Drywall Ceiling; Texture					0	
Women's Toilet Room	C	OH43702-MT-CL7	Drywall Ceiling; Texture					0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
Y = Regulated ACM (RACM) by definition
N = not RACM by definition
NF1/NF2 may be friable due to condition or may become friable during reno/demo
RESULT:
0 - Non-ACM
[+] = ACM [no other assessment required]
B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
(440) 951-3514

EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Main Building
Project: Pre-Renovation Asbestos Survey		Functional Space: 1st Floor

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Mechanical Room	E	OH43702-MR-PL1	6" Pipe Insulation	NQ	T		Y	[+]	Hard Fitting on Group D; Fiberglass Lines
	E	OH43702-MR-PL2	6" Pipe Insulation		T		Y	[+]	Hard Fitting on Group D; Fiberglass Lines
	E	OH43702-MR-PL3	6" Pipe Insulation		T		Y	[+]	Hard Fitting on Group D; Fiberglass Lines
	G	OH43702-MR-WS1	Window Sealant; Beige	NQ	M/NF2		N	[+],B	
	G	OH43702-MR-WS2	Window Sealant; Beige		M/NF2		N	[+],B	
	H	OH43702-MR-DS1	Door Sealant; Gray					0	
	H	OH43702-MR-DS2	Door Sealant; Gray					0	
Storage Room	F	OH43702-SR-WS1	Window Sealant; Gray	NQ	M/NF2		N	[+],B	
	F	OH43702-SR-WS2	Window Sealant; Gray		M/NF2		N	[+],B	
Entrance Lobby	I	OH43702-EL-DS1	Door Sealant; Dark Gray	NQ	M/NF2		N	[+],B	
	I	OH43702-EL-DS2	Door Sealant; Dark Gray		M/NF2		N	[+],B	
	J	OH43702-EL-WS1	Window Sealant; Light Gray					0	
	J	OH43702-EL-WS2	Window Sealant; Light Gray					0	

MATERIALS:
TYPE:
S - Surfacing
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M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
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D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
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FRIABLE:
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Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple — 9520 Dolphin Street SW. Strasburg, Ohio	Building: Filter Gallery
Project: Pre-Renovation Asbestos Survey	Functional Space: 1st Floor - Lower Level

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Building - Kalwall Window	K	OH43702-LL-DS1	Door Sealant; Light Gray					0	
	K	OH43702-LL-DS2	Door Sealant; Light Gray					0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
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N = not RACM by definition
NF1/NF2 may be friable due to condition or may become friable during reno/demo
RESULT:
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B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

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(440) 951-3514

EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Filter Gallery
Project: Pre-Renovation Asbestos Survey		Functional Space: 2nd Floor - Operator Gallery

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Entry	Q	OH43702-OG-DS1	Door Sealant; Gray					0	
Exit	Q	OH43702-OG-DS2	Door Sealant; Gray					0	
Door to Filter #2 (south)	R	OH43702-OG-DS3	Door Sealant; Gray					0	
Door to Filter #4 (south)	R	OH43702-OG-DS4	Door Sealant; Gray					0	
Stairwell North Kalwall Window	S	OH43702-OG-WS1	Window Sealant; Gray					0	
	S	OH43702-OG-WS2	Window Sealant; Gray					0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
Y = Regulated ACM (RACM) by definition
N = not RACM by definition
NF1/NF2 may be friable due to condition or may become friable during reno/demo
RESULT:
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B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
(440) 951-3514

EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Filter Room
Project: Pre-Renovation Asbestos Survey		Functional Space: As Indicated

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Filter Rm - Window Filter #1 - Original	T	OH43702-FR2-WS1	Window Sealant; Black					0	
Filter Rm - Window Filter #4 - Original	T	OH43702-FR2-WS2	Window Sealant; Black					0	
Filter Rm - Window Filter #5 - New	U	OH43702-FR2-WS3	Window Sealant; Black					0	
Filter Rm - Window Filter #6 - New	U	OH43702-FR2-WS4	Window Sealant; Black					0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
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N = not RACM by definition
NF1/NF2 may be friable due to condition or may become friable during reno/demo
RESULT:
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COMMENTS:

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NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
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EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Main WTP
Project: Pre-Renovation Asbestos Survey		Functional Space: 1st Floor

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Electrical Room									NO SUSPECT ACM
Generator Room	X	OH43702-GN-LS1	Louver Sealant; Gray					0	
	X	OH43702-GN-LS2	Louver Sealant; Gray					0	
	Y	OH43702-GN-DS1	Door Sealant; Gray					0	
	Y	OH43702-GN-DS2	Door Sealant; Gray					0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
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N = not RACM by definition
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RESULT:
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B = Verified by layering/point counting

COMMENTS:

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NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
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EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple — 9520 Dolphin Street SW. Strasburg, Ohio	Building: High Service Pump Room
Project: Pre-Renovation Asbestos Survey	Functional Space: As Indicated

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
High Service Pump Room	V	OH43702-GB-A1	Glass Block Window Sealant; Gray	NQ	M/NF2		N	[+],B	
	V	OH43702-GB-A2	Glass Block Window Sealant; Gray		M/NF2		N	[+],B	
	W	OH43702-GB-A3	Glass Block Mortar; Beige	NQ	M/NF2		N	[+],B	
	W	OH43702-GB-A4	Glass Block Mortar; Beige		M/NF2		N	[+],B	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
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N = not RACM by definition
NF1/NF2 may be friable due to condition or may become friable during reno/demo
RESULT:
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[+] = ACM [no other assessment required]
B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
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EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Aerator Building
Project: Pre-Renovation Asbestos Survey		Functional Space: West Larger Unit

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Roof - Screen Building	Z	OH43702-AW-R1	Rolled Roofing Core					0	
	Z	OH43702-AW-R4	Rolled Roofing Core					0	
	AA	OH43702-AW-R2	Roof Flashing					0	
	AA	OH43702-AW-R3	Roof Flashing					0	
Building - Kalwall Window	AB	OH43702-AW-B1	Window Sealant; Gray					0	
	AB	OH43702-AW-B2	Window Sealant; Gray					0	
Entry	AC	OH43702-AW-DS1	Door Sealant; Gray					0	
	AC	OH43702-AW-DS2	Door Sealant; Gray					0	

MATERIALS:
TYPE:
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M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
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D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
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N = not RACM by definition
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RESULT:
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B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

EA GROUP
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Mentor, OH 44060-5314
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EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple — 9520 Dolphin Street SW. Strasburg, Ohio — Building: Aerator Building

Project: Pre-Renovation Asbestos Survey — Functional Space: East Smaller Unit

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Building - Kalwall Window	AD	OH43702-AE-B1	Window Sealant; Gray					0	
	AD	OH43702-AE-B2	Window Sealant; Gray					0	
Entry	AE	OH43702-AE-DS1	Door Sealant; Gray					0	
	AE	OH43702-AE-DS2	Door Sealant; Gray					0	

MATERIALS:
TYPE:
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M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
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RESULT:
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B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
(440) 951-3514

EAG Technician(s): Corey Falatic — ES 36126 — EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Maintenance Garage
Project: Pre-Renovation Asbestos Survey		Functional Space: As Indicated

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Entrance Door	L	OH43702-MG-DS1	Door Sealant; Dark Gray					0	
	L	OH43702-MG-DS2	Door Sealant; Dark Gray					0	
Maintenance Garage	D	---	Pipe Insulation; Fiberglass		N/S			0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
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N = not RACM by definition
NF1/NF2 may be friable due to condition or may become friable during reno/demo
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B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
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EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Chlorination and Cylinder Storage Rooms
Project: Pre-Renovation Asbestos Survey		Functional Space: As Indicated

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Chlorination Room	M	OH43702-CL-WS1	Window Sealant; Gray					0	
	M	OH43702-CL-WS2	Window Sealant; Gray					0	
Chlorine Cylinder Room	N	OH43702-CL-DS1	Door Sealant; Brown					0	
Chlorination Room	N	OH43702-CL-DS4	Door Sealant; Brown					0	
Observation - Double Door	O	OH43702-CL-DS2	Door Sealant; Gray					0	
Observation Room Door	O	OH43702-CL-DS3	Door Sealant; Gray					0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
LF = Linear Feet; EA = each
NQ = not quantified
FRIABLE:
Y = Regulated ACM (RACM) by definition
N = not RACM by definition
NF1/NF2 may be friable due to condition or may become friable during reno/demo
RESULT:
0 - Non-ACM
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B = Verified by layering/point counting

COMMENTS:

Sampling limited to designated material(s) in designated area(s)

NQ = No Quantity

EA GROUP
7118 Industrial Park Blvd.
Mentor, OH 44060-5314
(440) 951-3514

EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

ASBESTOS INSPECTION DATA SHEET

Client: Burgess & Niple	9520 Dolphin Street SW. Strasburg, Ohio	Building: Fluoridation Building
Project: Pre-Renovation Asbestos Survey		Functional Space: As Indicated

LOCATION	Group	ID # OH43702	MATERIAL DESCRIPTION	Quantity	Material		FRIABLE	RESULT	NOTES
					Type	Cond			
Entrance Door - Chlorination	P	OH43702-FL-DS1	Door Sealant; Gray					0	
	P	OH43702-FL-DS2	Door Sealant; Gray					0	

MATERIALS:
TYPE:
S - Surfacing
T - Thermal
M - Miscellaneous
NF1 - Non-friable Cat. I
NF2 - Non-friable Cat. II
N/S = not suspect
CONDITION: [if relevant]
ND - No Damage
D - Damage
SD - Significant Damage

QUANTITY = Square Feet unless noted
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FRIABLE:
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COMMENTS:

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NQ = No Quantity

EA GROUP
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EAG Technician(s): Corey Falatic ES 36126 EAG OH43702

Survey Date(s): September 18 & 25, 2020

EA GROUP
Environmental Analysis and Management

APPENDIX B

City of Canton Sugar Creek Asbestos Test Locations

Note: Corresponding EA Group Homogeneous Group (HG) shown in brackets [ ]

City of Canton Sugar Creek Water Treatment Plant -
9520 Dolphin Road, SW, (State Route 212, 9 miles west of Bolivar, OH)
Strasburg, OH (Tuscarawas County)

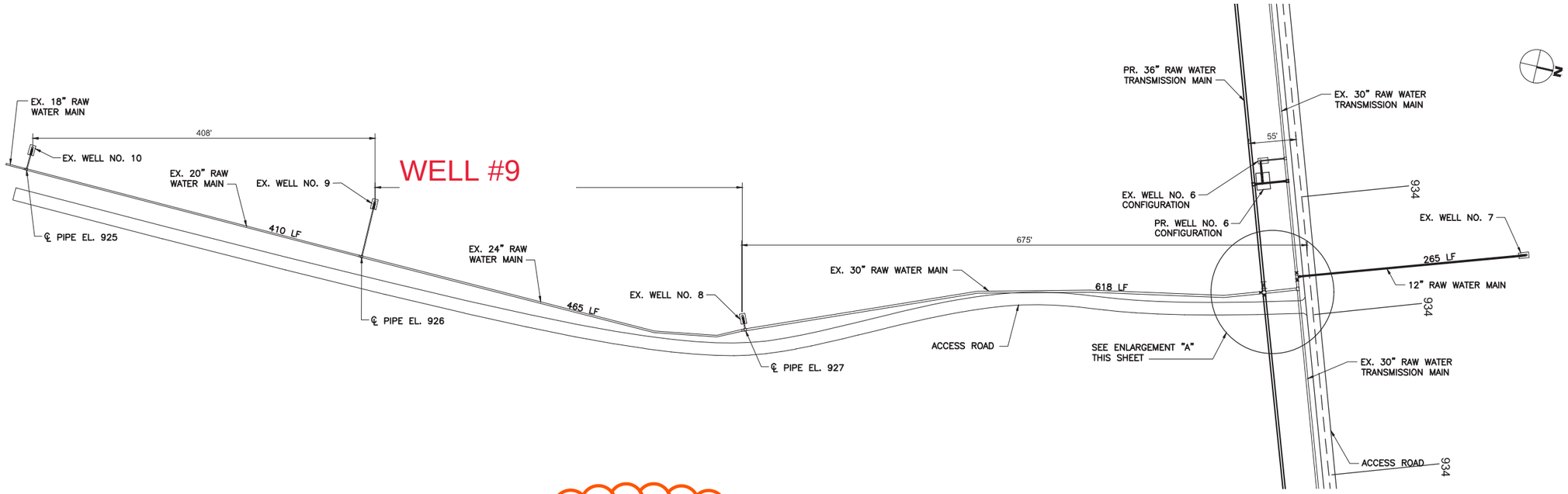
Item	ID #	EA Group HG	Level /Location	Description
Roof Plan			**No Work on Main Plant**	
See sheet			**Main Bldg. - 1st & 2nd Floor**	
MB2	RS-WS1	A	2nd Floor - Rear stairwell	Window Sealant
MB2	ML-CL1	B	2nd Floor Lobby Ceiling	Drywall Ceiling - Core Sample of Insulation
MB2	OO-CL2	B	2nd Floor Operator Office	Drywall Ceiling - Core Sample of Insulation
MB2	CR-CL3	B	2nd Floor Control Room	Drywall Ceiling - Core Sample of Insulation
MB2	LAB-CL4	B	2nd Floor Laboratory	Drywall Ceiling - Core Sample of Insulation
MB2	ML-CL5	C	2nd Floor Mens Locker Room	Drywall Ceiling - Core Sample of Insulation
MB2	MT-CL6	C	2nd Floor Mens Toilet Room	Drywall Ceiling - Core Sample of Insulation
MB2	MT-CL7	C	2nd Floor Womens Toilet Room	Drywall Ceiling - Core Sample of Insulation
MB2	MR-DI1	Not observed	1st Floor - Mechanical Room	Ductwork -Core Insulation sample
MB1	MR-PI1	E	1st Floor - Mechanical Room	Hot Water Supply - Pipe Insulation
MB1	MR-PI2	E	1st Floor - Mechanical Room	Hot Water Return - Pipe Insulation
MB1	MR-PI3	E	1st Floor - Mechanical Room	Cold Water- Pipe Insulation
MB1	SR-WS2	F	1st Floor - Storage Room	Window Sealant
MB1	SR-WS3	F	1st Floor - Storage Room	Window Sealant
MB1	MR-WS1	G	1st Floor - Mechanical Room	Window Sealant
MB1	MR-DS1	H	1st Floor - Mechanical Room	Door Sealant
MB1	EL -DS1	I	1st Floor - Entrance Lobby	Door Sealant - Rear Door Frame
MB1	EL -WS4	J	1st Floor - Entrance Lobby	Window Sealant - Window at East Wall
MB1	EL -WS5	J	1st Floor - Entrance Lobby	Window Sealant - Window at West Wall
See sheet			**Filter Gallery 1st Floor - Lower Level**	
FG1	LL-DS1	K	Building - Kalwall Window	Door Sealant - End Filter #3/#6
See sheet			**Filter Gallery - 2nd Floor Operator Gallery**	
FG2	OG-DS1	Q	Door Sealant - Entry	Door Sealant
FG2	OG-DS2	Q	Door Sealant -- Exit	Door Sealant
FG2	OG-DS3	R	Door to Filter #2	Door Sealant
FG2	OG-DS4	R	Door to Filter #4	Door Sealant
FG2	OG-WS1	S	Stairwell North Kalwall Window	Window Sealant
FG2	OG-WS2	S	Stairwell Kalwall Window	Window Sealant
See sheet			**Filter Room - Original Filters #1,#2, #3, #4 and New Filters #3 and #6**	
FR2	FR2- WS1	T	Window Filter #1- Original	Kalwall Sealant at Jamb (N. Wall Filter #1)
FR2	FR2-WS2	T	Window Filter #2- Original	Kalwall Sealant at Jamb S. Wall Filter 2
FR2	FR2-WS3	T	Window Filter #3- Original	Kalwall Sealant at Jamb (N. Wall Filter #3)
FR2	FR2-WS4	T	Window Filter #4- Original	Kalwall Sealant at Jamb S. Wall Filter 4
FR2	FR21-PI1	Not observed	Baseboard Heater - Filter #2	Paint Sample Hot Water Piping Insulation
FR2	FR2-WS5	U	Window Filter #5- New	Kalwall Sealant at Jamb (N. Wall Filter #5)
FR2	FR2-WS6	U	Window Filter #6- New	Kalwall Sealant at Jamb S. Wall Filter 6
FR2	FR2-PI2	Not observed	Baseboard Heater- Filter #6	Paint Sample Hot Water Piping Insulation
See sheet			**High Service Pump Room**	
HSP	GB-A1	V	High Service Pump Room	Glass Block Window Cault East End at Wall
HSP	GB-A2	V	High Service Pump Room	Glass Block Window Caulk West End a Wall
HSP	GB-A3	W	High Service Pump Room	Glass Block Window Mortar East 1/3 Point
HSP	GB-A4	W	High Service Pump Room	Glass Block Window Mortar West 1/3 Point
HSP	Spare		High Service Pump Room	Miscellaneous

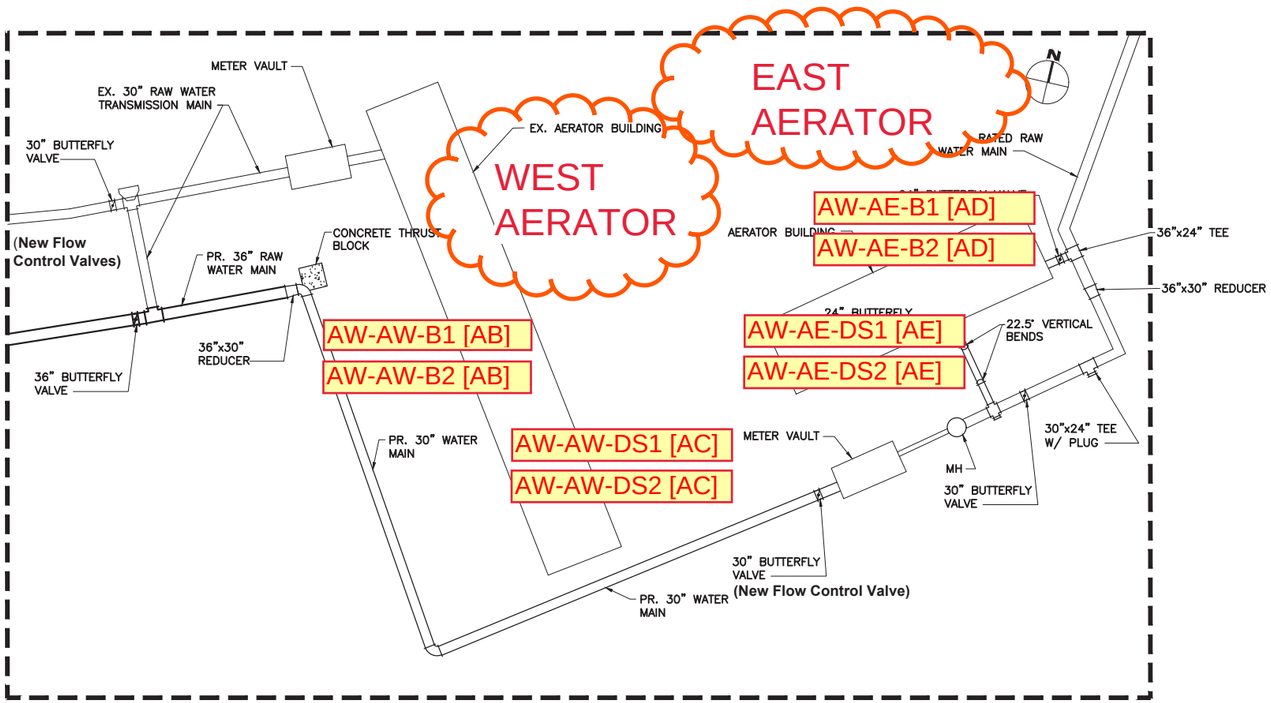
City of Canton Sugar Creek Water Treatment Plant -
9520 Dolphin Road, SW, (State Route 212, 9 miles west of Bolivar, OH)
Strasburg, OH (Tuscarawas County)

Item	ID #	EA Group HG	Level /Location	Description
See sheet			**Main WTP - Electrical Room**	
EL	ER - DS1	Not observed	First Floor - Screen Bldg. -	Door Sealant at Overhead Door
EL	ER - DI1	Not observed	First Floor - Screen Bldg. -	Main Ductwork Insulaton
See sheet			**Main WTP - Generator Room**	
GEN	LS-1	X	First Floor - Generator Bldg.	Louver Sealant at Exterior Bldg Intake
GEN	LS-2	X	First Floor - Generator Bldg.	Louver Sealant at Exterior Bldg Exhaust
GEN	DS-1	Y	First Floor - Generator Bldg.	Door Sealant at Generator Room EntryDoor
See sheet			**Aerator Bldg - West Larger Unit**	
AW	AW-R1	Z	Roof - Screen Bldg.	Core Sample of Roof Insulation - 2/3 Point
AW	AW-R2	AA	Roof - Screen Bldg.	Roof Flashing - East Parapet - Middle
AW	AW-R3	AA	Roof - Screen Bldg.	Roof Flashing - West Parapet - Middle
AW	AW-B1	AB	Building - Kalwall Window	Window Sealant
AW	AW-DS1	AC	Door Sealant - Entry	Door Sealant
See sheet			**Aerator Bldg - East Smaller Unit**	
AE	AE-B1	AD	Building - Kalwall Window	Window Sealant
AE	AE-DS1	AE	Door Sealant - Entry	Door Sealant
See sheet			**Maintenance Garage**	
MG	MG-DS1	Not observed	Overhead Door	Window Sealant
MG	MG-DS3	L	Entrance Door	Door Sealant
MG	MG-DS4	L	Entrance Door	Door Sealant
MG	MG-WS2	No windows	Building - Kalwall Window	Window Sealant
MG	MG-PI1	D [not suspect]	Pipe Insulation	Pipe Insulation
sheet MPS -26			**Chlorination and Cylinder Storage Rooms**	
CL	CL-WS1	M	Chlorination Room	Window Sealant
CL	CL-DS1	N	Chorine Cylinder Room	Door Sealant
CL	CL-DS2	O	Observation- Dbl Door	Door Sealant
CL	CL-DS3	O	Observation Rm Door	Door Sealant
CL	CL-DS4	N	Chlorination Room	Door Sealant
See sheet			**Fluoridation Building**	
FL	FL-WS1	No windows	Window	Window Sealant
FL	FL-DS1	P	Entrance Door -Chlorination	Door Sealant

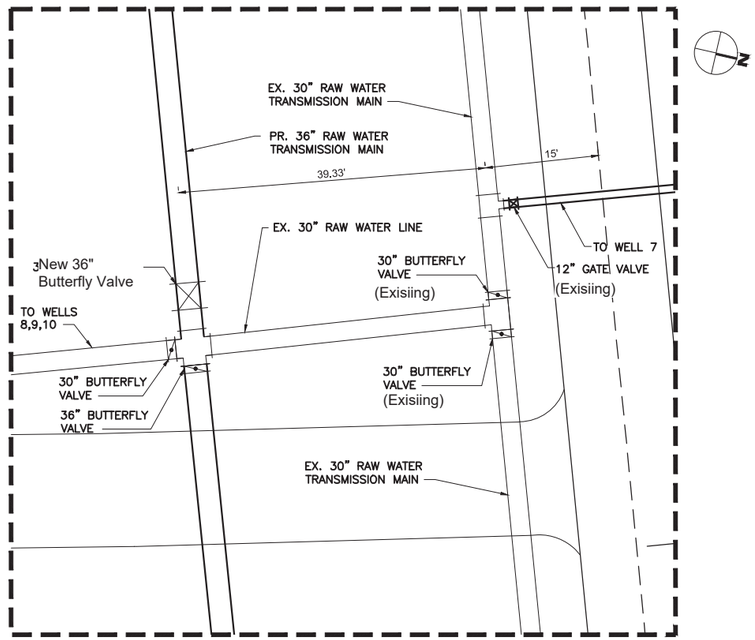
Rows shaded RED inidicated confirmed asbestos-containing material (ACM); all remaining non-ACM

PLOTTED: 12/13/2019 7:50:01 AM





ENLARGEMENT 'B'
SCALE: 1"=20'



ENLARGEMENT 'A'
SCALE: 1"=10'

Exhibit $4-3
Wellfield - Raw Water Transmission Mains
Well s#7 - #10 and Enlarged Details

BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

CITY OF CANTON

NO.	DESCRIPTION REVISIONS	DATE

JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
APPROVED BY:	XXX
SCALE:	1"=60'

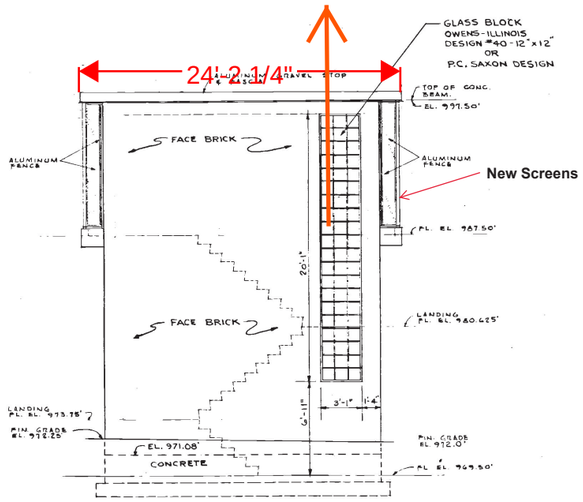
SITE LAYOUT

2

SHEET XX OF 99

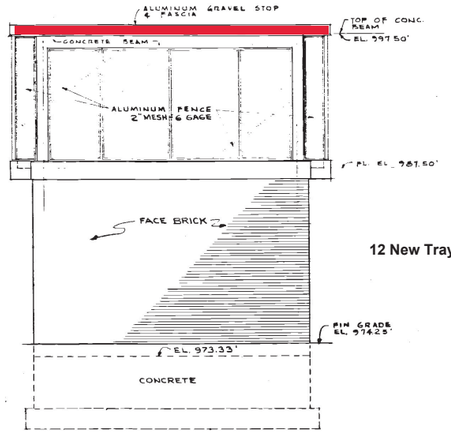
P:\PR57484\Cadd\Sheets\1 Site-1.dwg 12/13/2019 7:48:26 AM Baker, Gwen

WEST AERATOR

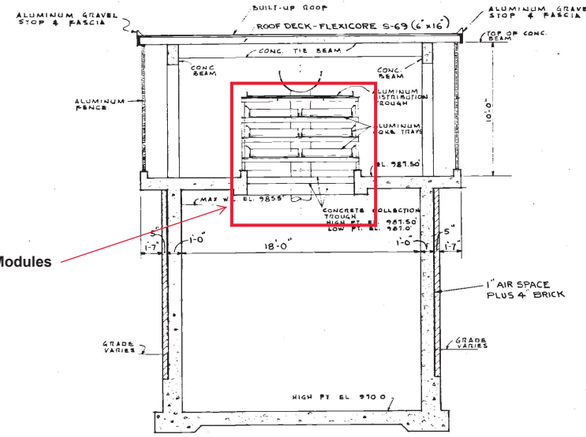


NORTH ELEVATION
SCALE 3/16" = 1'-0"

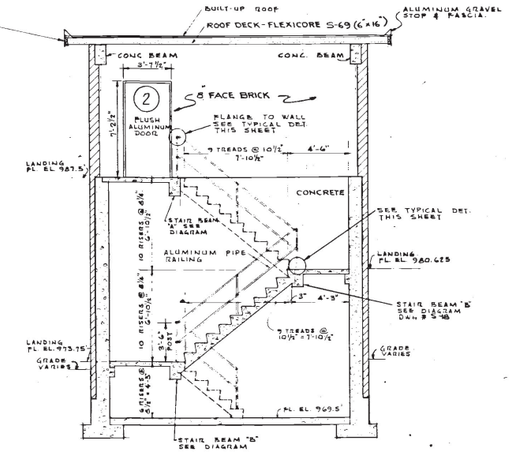
New Roof Planks and Single-Ply Roofing



SOUTH ELEVATION
SCALE 3/16" = 1'-0"

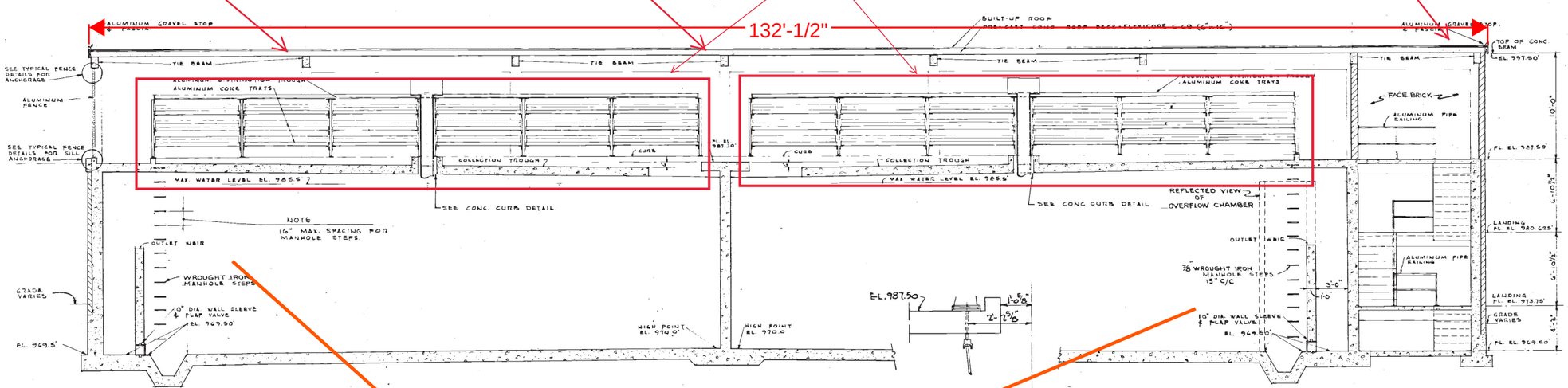


SECTION "A-A"
SCALE 3/16" = 1'-0"

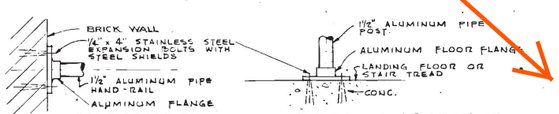


SECTION "B-B"
SCALE 3/16" = 1'-0"

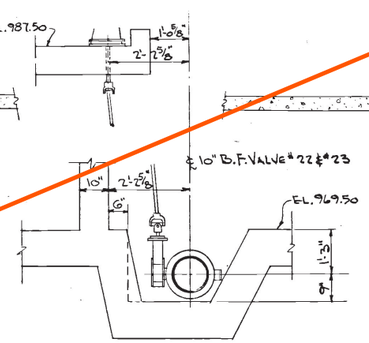
AW-AW-R1 [Z]
AW-AW-R4 [Z]
AW-AW-R2 [AA]
AW-AW-R3 [AA]
12 New Tray Modules



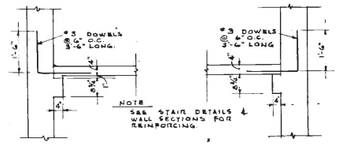
SECTION "C-C"
SCALE 3/16" = 1'-0"



TYPICAL DETAILS - HAND-RAIL ANCHORAGE
NO SCALE

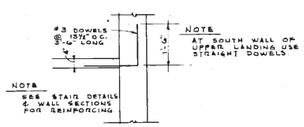


DETAIL "1"
No Scale



TYP LANDING CONN. @ EAST WALL.
SCALE 3/8" = 1'-0"

TYP LANDING CONN @ WEST WALL.
SCALE 3/8" = 1'-0"



TYP LANDING CONN. @ NORTH & SOUTH STAIR WALLS.
SCALE 3/8" = 1'-0"

4-11-61	C.K.W.	Revised

CITY OF CANTON, OHIO
DEPARTMENT OF PUBLIC SERVICE - WATER WORKS DEPT.

BEISWENGER, HOCH, & ASSOCIATES
CONSULTING ENGINEERS
AKRON, OHIO

Exhibit 34-5Aeartor (Weat)

AERATOR SECTIONS

DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	DRAWING NO.
JM	LEA		JTH	JTH	10-15-59	S-17-1

REPLACE GLASS BLOCK WINDOW WALL AND INSTALLL TINTED THERMOPANE WINDOWS WITH ALUMNUM MULLIONS

REMOVE EXISTING DUCTOWRK AND LOUVER AND CUT IN NEW OPENING FOR OVERHEAD DOOR

NEW 12' W X 12' H OVERHEAD COILING DOOR

FROST SLABS

NEW OVERHEAD COILING DOOR WITH FIRELINK

GRAVEL

4' HIGH CONCRETE PAD (TO BE REMOVED AND FLOOR TILED)

REPLACE EX. 16" CHECK & BUTTERFLY VALVE (TYP. 5)

REBUILD EX. PUMP BASE WITH SCH. 80 ELBOW. REMOVE AND REBUILD PUMP ROTATING PARTS

REBUILD OR REPLACE EX. SYNCHRONOUS MOTORS (TYP. 4)

12" STL. CLEARWELL VENT

HEADER SECTION NOT REPLACED USED EXISTING

8'-0"±

24" SCH. 40 BLK STL. HIGH SERVICE PUMP DISCHARGE HEADER

16" STL. PUMP DISCHARGE

PUMP #1 PUMP #2 PUMP #3 PUMP #4 PUMP #5

MH LID

9'-0"

HIGH SERVICE PUMP ROOM E102

EX. INDUCTION MOTOR REPLACE PUMP HEAD. REMOVE AND REBUILD PUMP ROTATING PARTS

HOUSE SERVICE PUMP

F.D. (TYP.)

WASH WATER PUMP

Replace with new Backwash Pump w/VFD

2'-6" x 3'-0" ALUMINUM ACCESS DOOR W/"LADDER UP" SAFETY POST AND LOCK, BILCO TYPE 'S' OR EQUAL

NOTE: REPLACE ALL DAMAGED FLOOR TILE TO MATCH EXISTING.

#6 DOWELS x 2'-8" W/8" MIN. EMBEDMENT, ANCHOR W/HILTI HIT C-100 OR EQUAL, LAP OVER TOP OF OUTSIDE #8 BARS IN BEAM, TYP.

5,746.64 sf

MOTOR STARTERS

NEW ELECTRICAL 5 KV SWITCHGEAR AND MCC W/ VFDS

DAY TANK

GENERATOR

ELECTRICAL ROOM E103

NEW FIRE-RATED DOOR

10'x10' OVERHEAD DOOR

SWITCH-GEAR

MAIN SWITCHBOARD & TRANSFORMER

NEW OVERHEAD COILING DOOR

CHEMICAL ROOM E104

STORAGE ROOM E105

BOILER EQUIPMENT ROOM E106

Storage Rm

Mechanical Rm

DEHUMIDIFY AREA BEHIND 1ST FLOOR LOBBY FILTER PIPING GALLERY E101

MB1-M-DI1 [Not Observed]

MB1-MR-PI1 [E]
MB1-MR-PI2 [E]
MB1-MR-PI3 [E]

MB1-MR-WS1 [F]
MB1-MR-WS2 [F]

MB1-SR-WS2 [F]
MB1-SR-WS3 [F]

NEW ALUMINUM DOORS AND HADWARE
NEW THERMOPANE ALUMINUM WINDOWS

MB1-MR-DS1 [H]
MB1-MR-DS2 [H]

30'-0" 27'-4" 3'-4" 10'-0" 10'-0" 3'-4" 1'-4"

2'-8" 14'-0" 2'-8" 17'-4" 19'-4" 8" 1" EXP. JOINT

6'-8" 3'-4"

3' 4" 3' 4"

FLOOR PLAN
SCALE: 3/16" = 1'-0"

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

Exhibit 4-15
High Service Pump and Piping Plan

BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

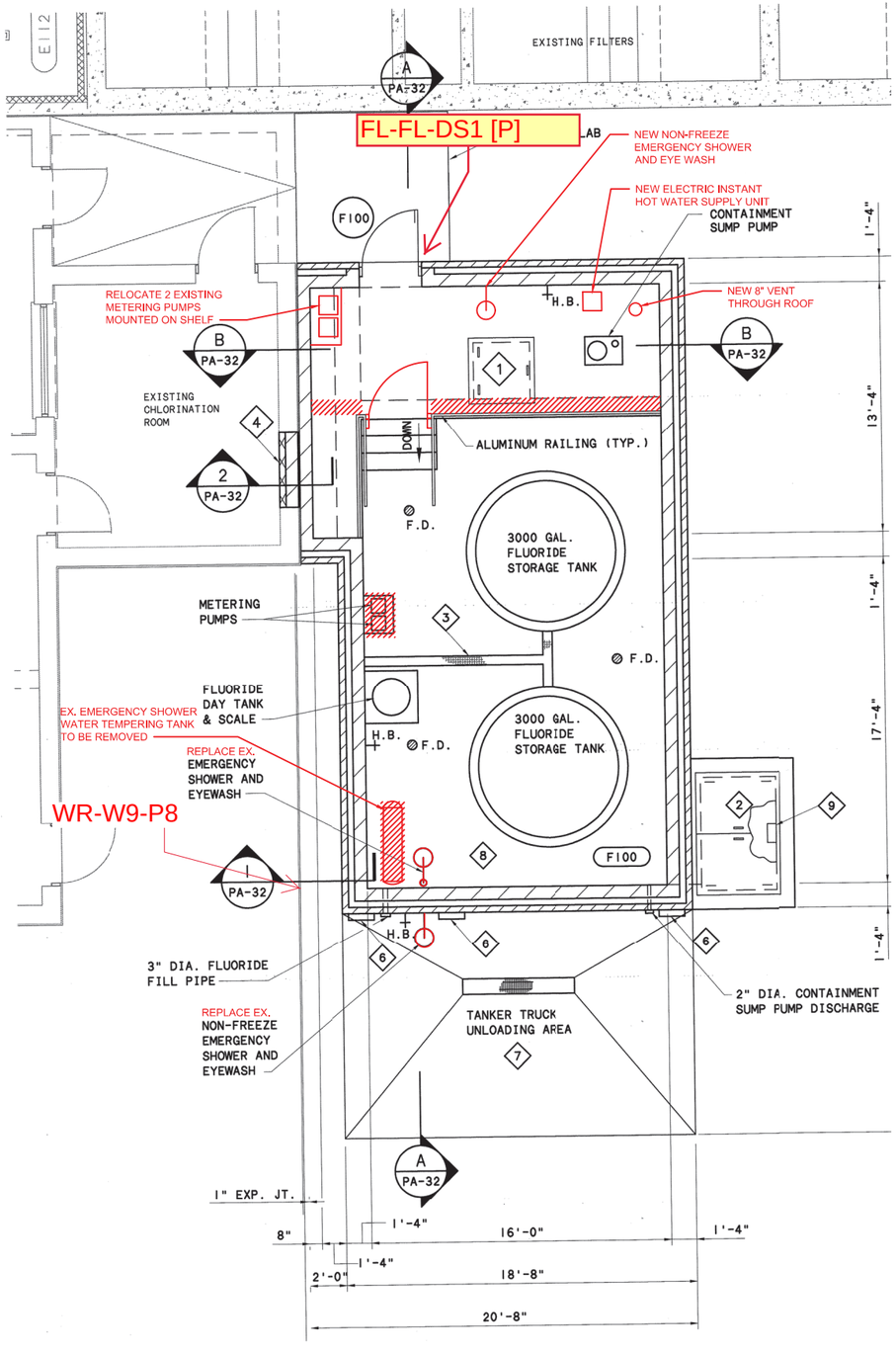
CITY OF CANTON

NO.	DESCRIPTION REVISIONS	DATE

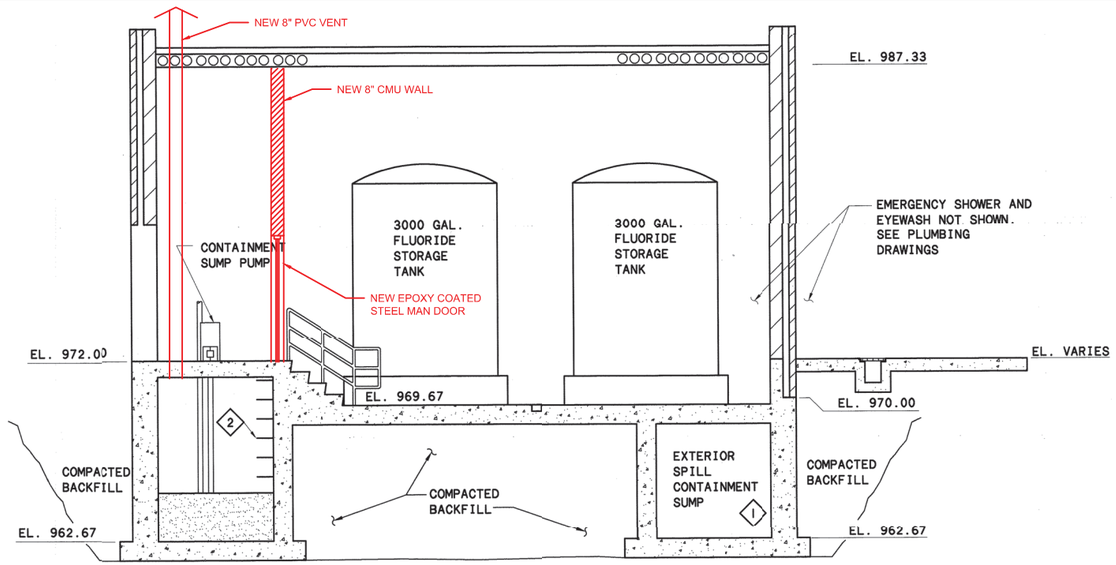
JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
APPROVED BY:	XXX
SCALE:	NONE

PUMP ROOM FLOOR PLAN

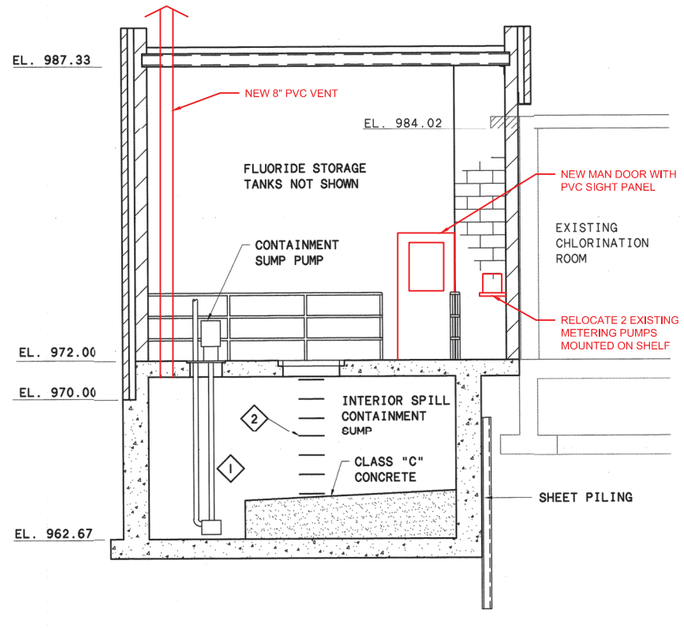
SHEET OF



FLOOR PLAN
SCALE: 1/4" = 1'-0"



SECTION A PA-31
SCALE: 1/4" = 1'-0"



SECTION B PA-31
SCALE: 1/4" = 1'-0"

BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

CITY OF CANTON

NO.	DESCRIPTION REVISIONS	DATE

JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
APPROVED BY:	XXX
SCALE:	NONE

FLUORIDE BUILDING

SHEET OF

Front Lobby Entrance with Elevator

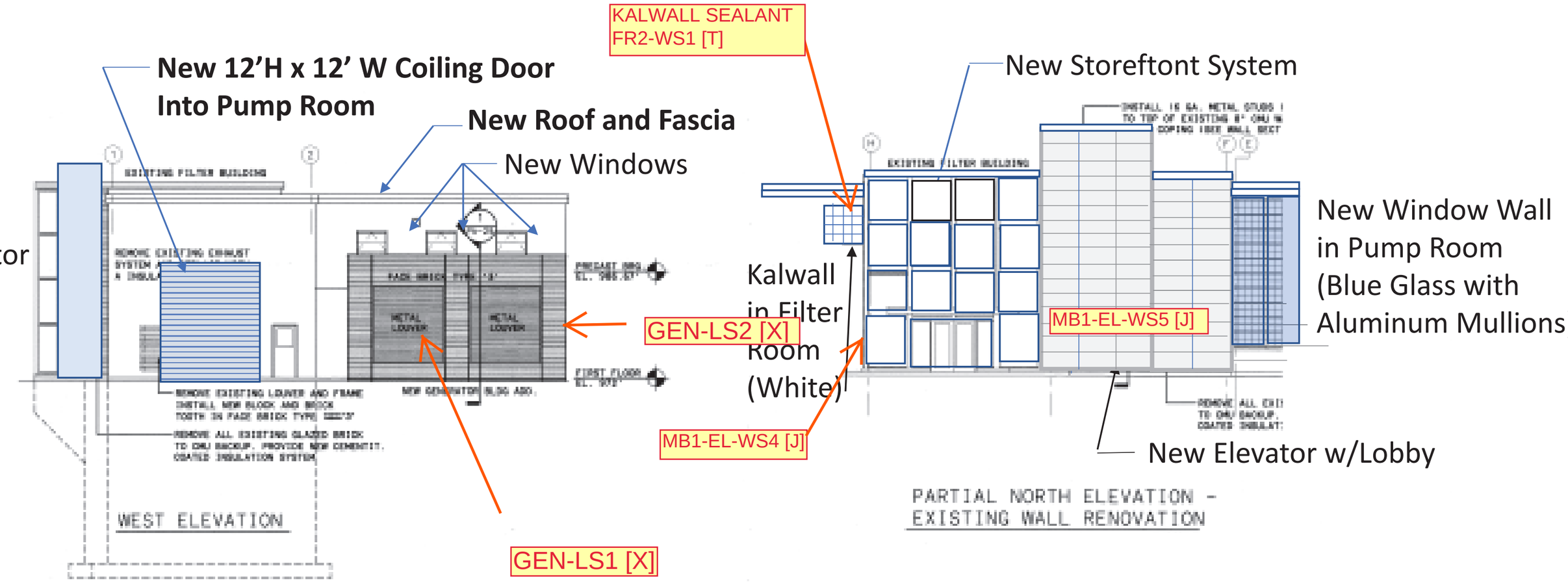
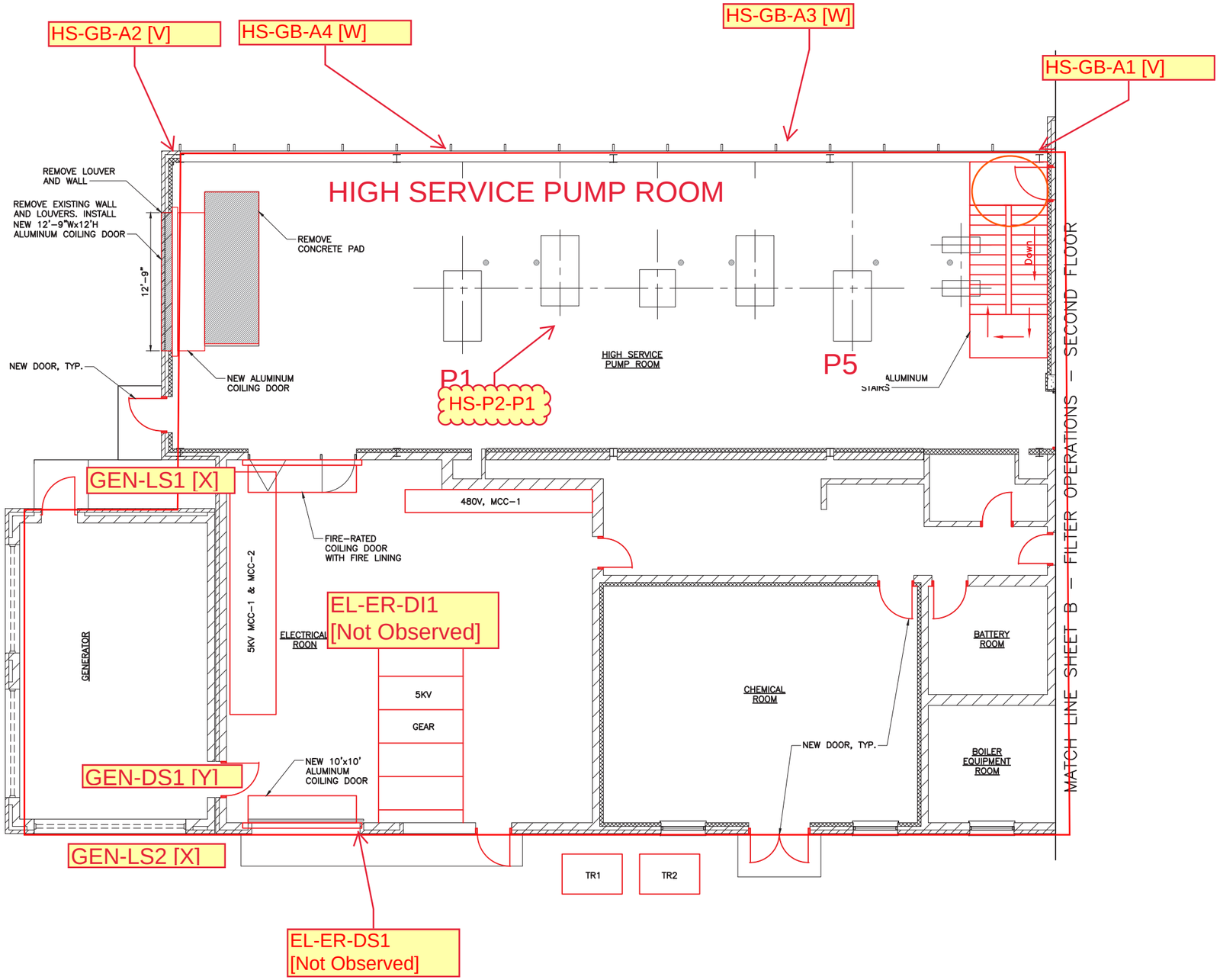


Exhibit 4-22 Front Entrance with Elevator



BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

CITY OF CANTON
CAPITAL IMPROVEMENTS PROJECT

NO.	DESCRIPTION	DATE
	REVISIONS	

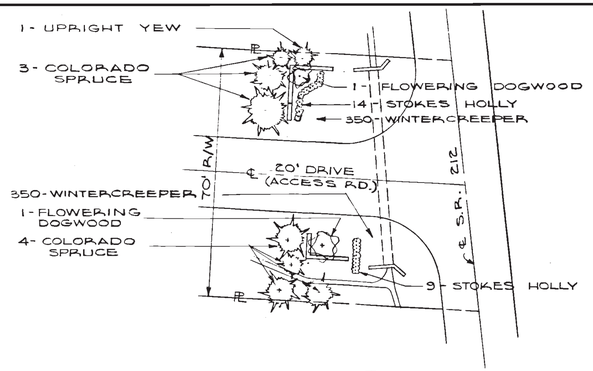
JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	CMS
DRAWN BY:	KAS
CHECKED BY:	CMS
APPROVED BY:	CMS
SCALE:	3/16"=1'-0"

PUMP ROOM AND GARAGE AREA

A

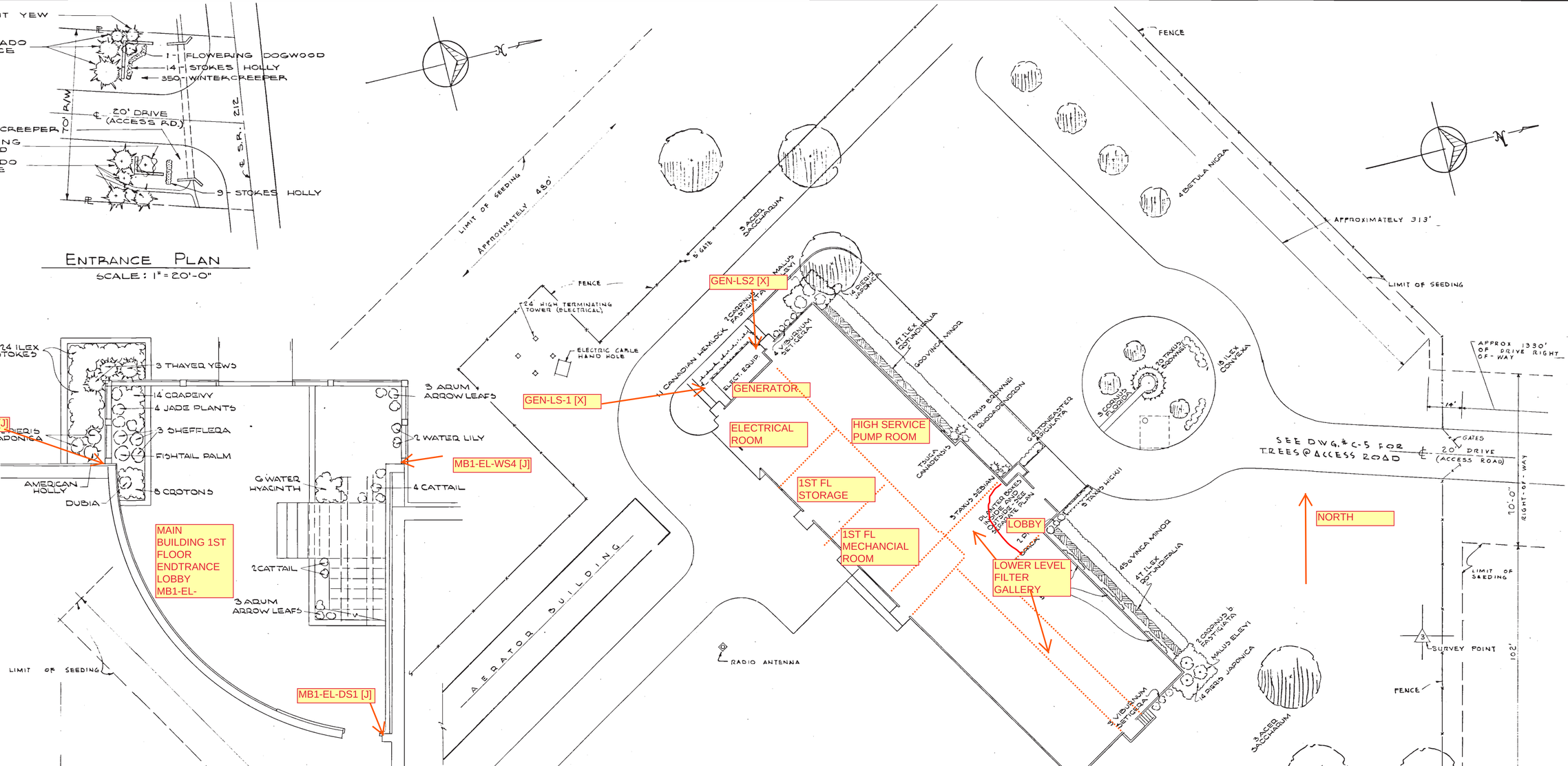
SHEET 1 OF ----

Exhibit 4-24 Electrical - Main Swtichgear
Electrical Room Floor Plan



ENTRANCE PLAN
SCALE: 1" = 20'-0"

VESTIBULE PLAN
(FLOOR ELEV. 972'-0")
SCALE: ¼" = 1'-0"



SITE LANDSCAPING PLAN
SCALE: 1" = 20'-0"

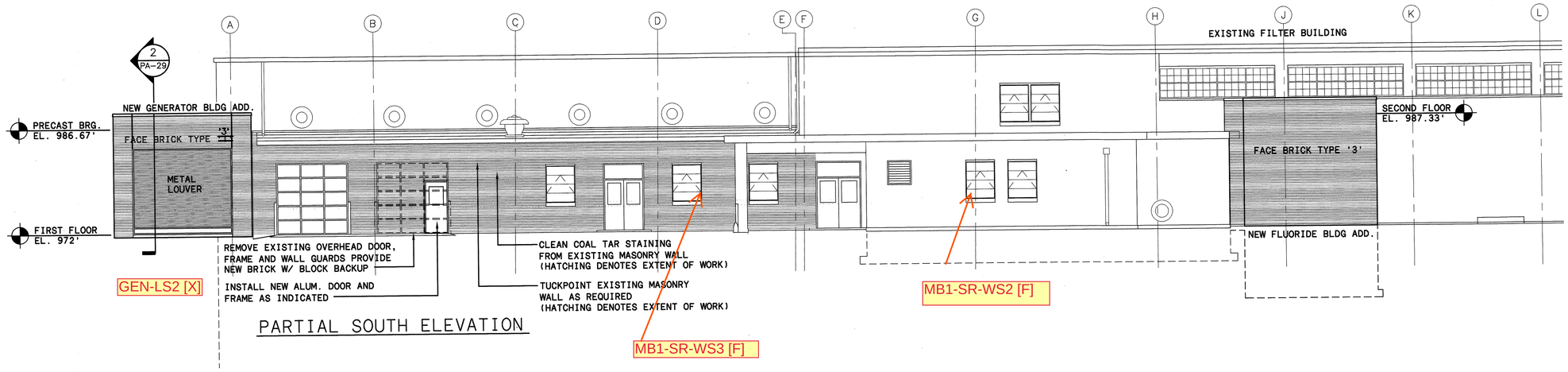
NOTE:
ALL DISTURBED GRASS AREAS TO BE SEEDED. "LIMIT OF SEEDING" INDICATED ON THIS PLAN APPLIES TO AREA OF GRADING FOR BUILDINGS & ACCESS ROAD

CITY OF CANTON, OHIO
DEPARTMENT OF PUBLIC SERVICE - WATER WORKS DEPT.

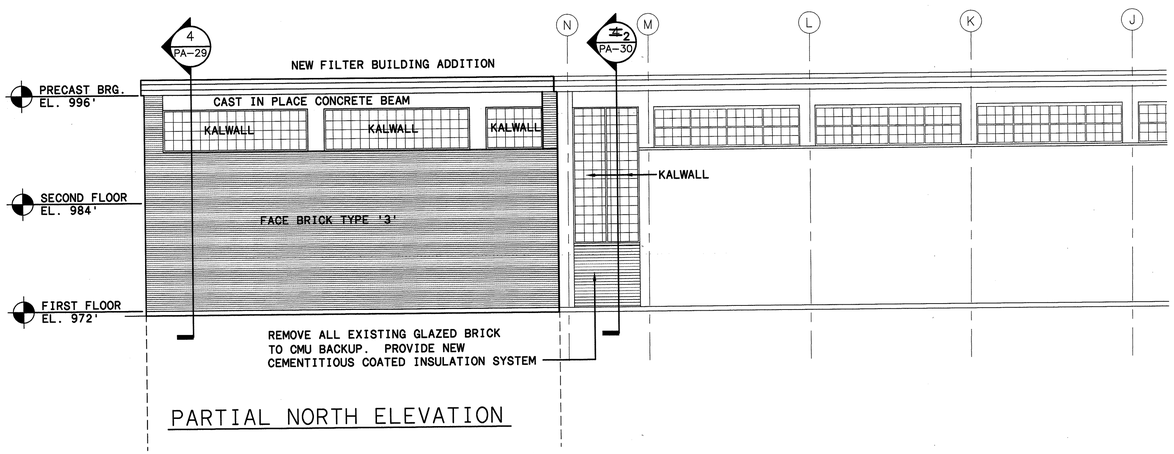
BEISWENGER, HOCH, & ASSOCIATES
CONSULTING ENGINEERS
AKRON, OHIO

LANDSCAPE & SEEDING PLAN

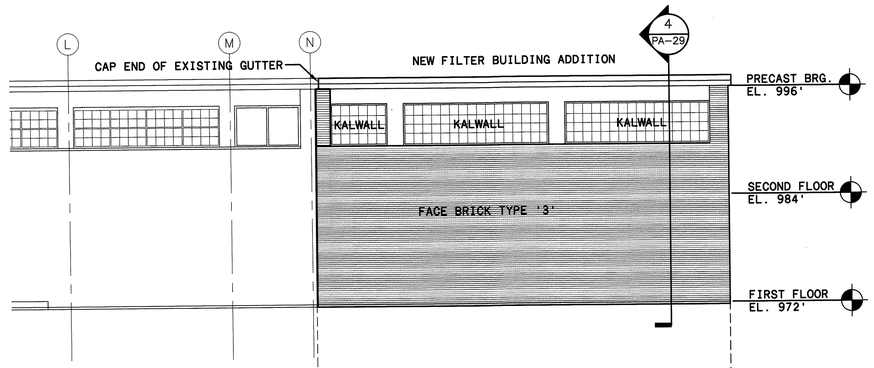
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	DRAWING NO.
ST	ST		C. G.	JTM	10-15-59	C-6



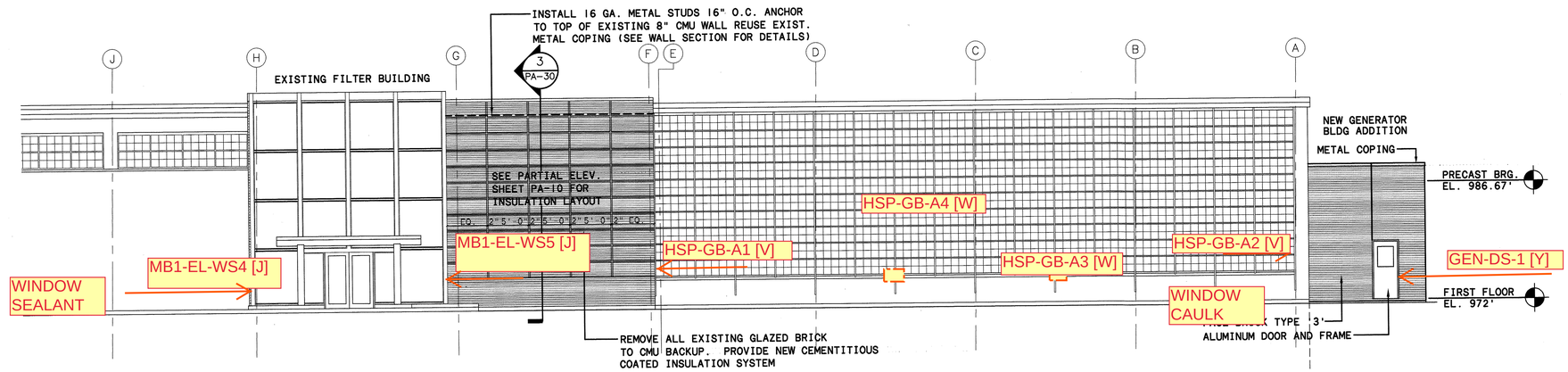
PARTIAL SOUTH ELEVATION



PARTIAL NORTH ELEVATION



PARTIAL SOUTH ELEVATION



PARTIAL NORTH ELEVATION

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

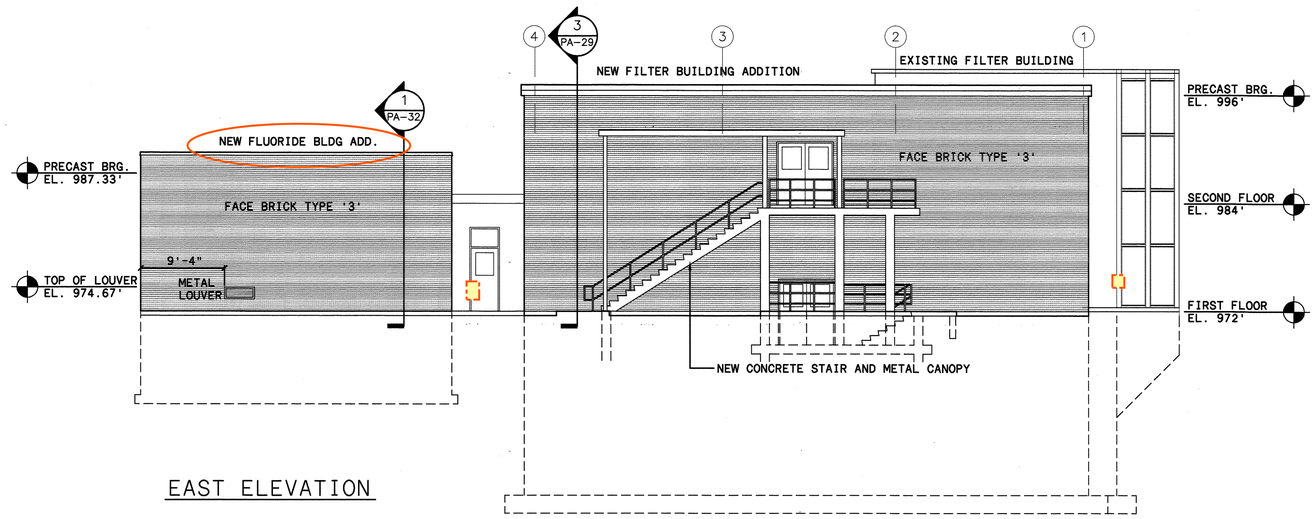
CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	DJK
DRAWN BY:	JNV
CHECKED BY:	ASW
APPROVED BY:	DJK
DATE:	OCTOBER 1995

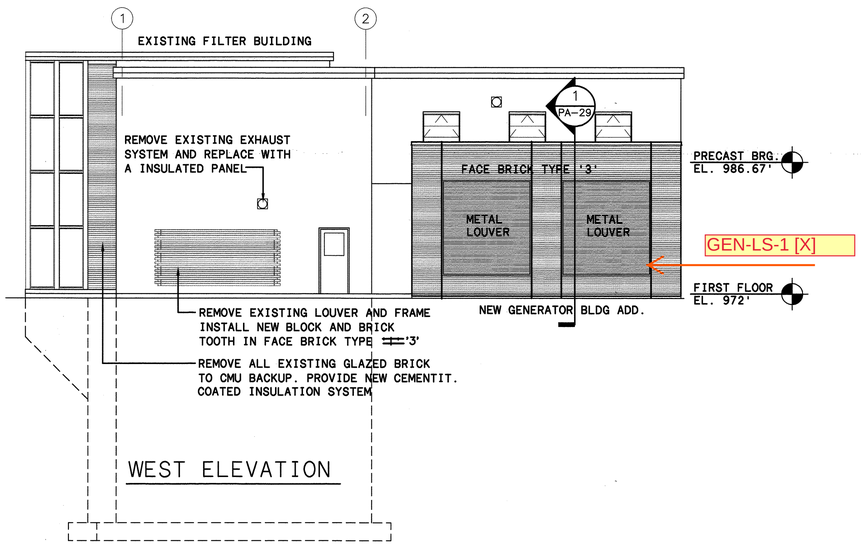
WATER PLANT BUILDING ELEVATIONS

SCALE: 1/8" = 1'-0"
SHEET: PA-9
18 OF 104

P:\PR16162\CADD\PA-9-SC.DWG 8-12-98 11:18:12 am EST



EAST ELEVATION



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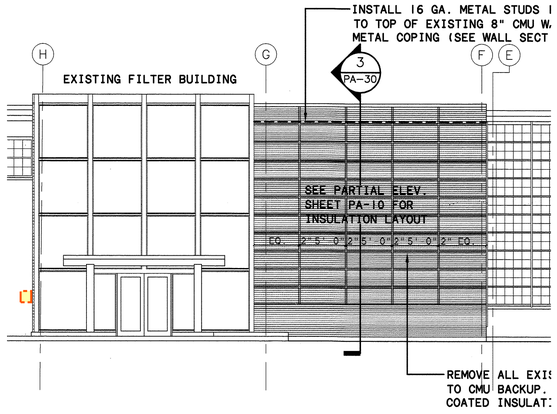

PARTIAL NORTH ELEVATION -
EXISTING WALL RENOVATION

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	DJK
DRAWN BY:	JNV
CHECKED BY:	ASW
APPROVED BY:	DJK
DATE:	OCTOBER 1995

WATER PLANT BUILDING ELEVATIONS

SCALE: 1/8" = 1'-0"
SHEET: PA-10
19 of 104

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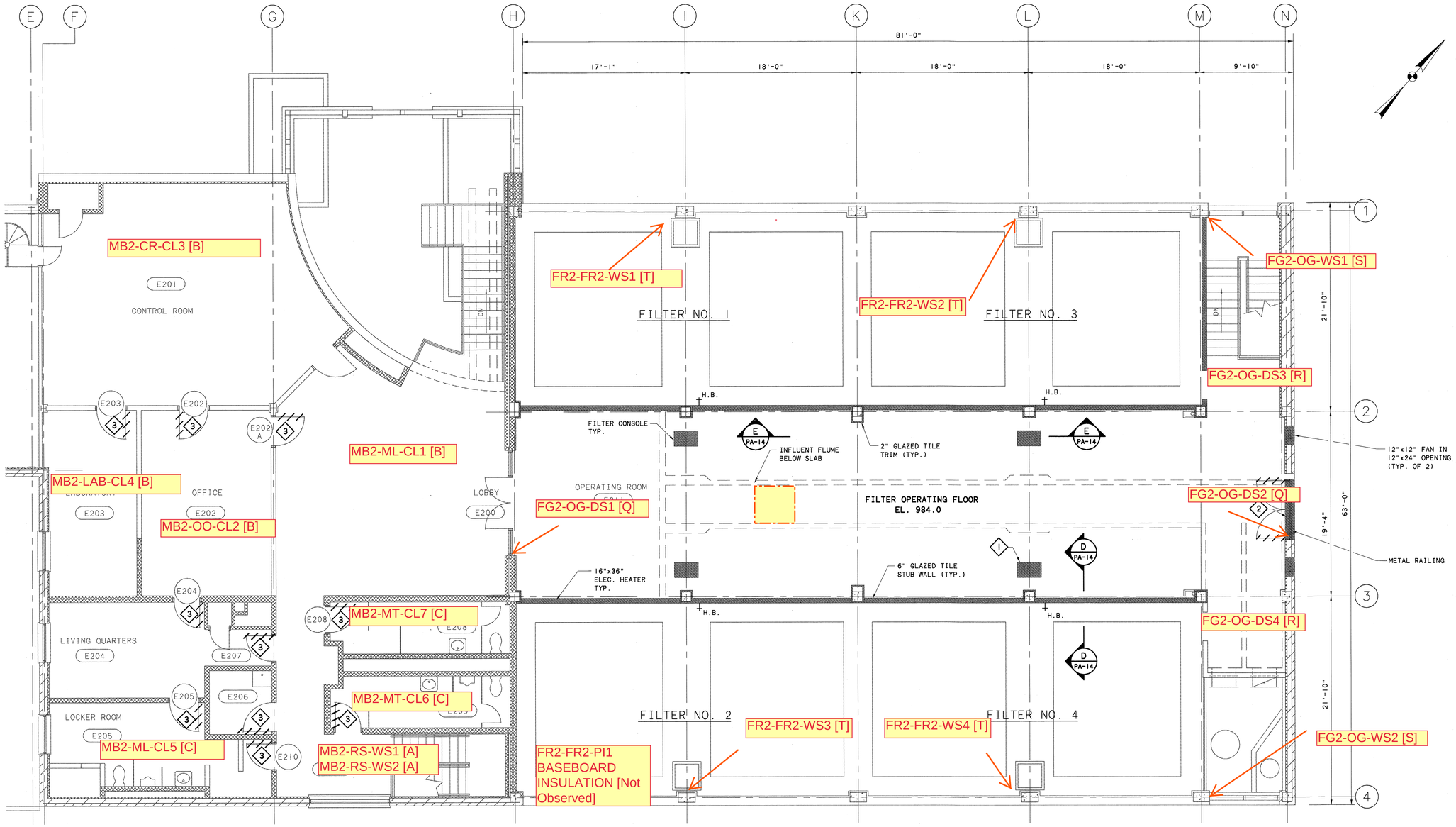

PARTIAL PLAN

SCALE: 3/16" = 1'-0"

3 REMOVE DOOR AND MAINTAIN FRAME.

2 REMOVE EXISTING DOUBLE DOORS AND RAILING.

1 ELECTRICAL CONTRACTOR SHALL REMOVE EXISTING FILTER CONSOLES.

REVISED 8-98 AS CONSTRUCTED
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NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	WEL
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

EXISTING FILTERS
OPERATING FLOOR PLAN
DEMOLITION

SCALE: AS NOTED
SHEET: PA-13
22 OF 104
Page 1843 of 1978

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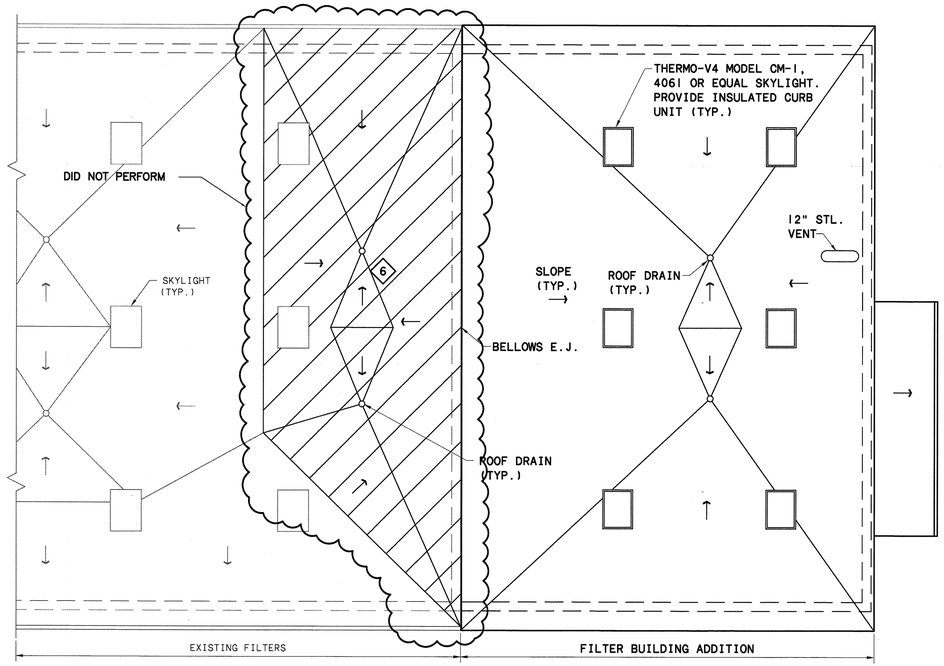
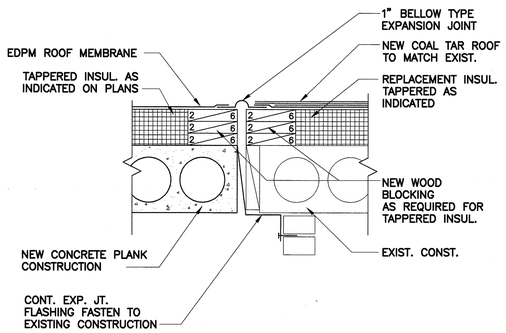


ROOF PLAN

SCALE: 1/8" = 1'-0"

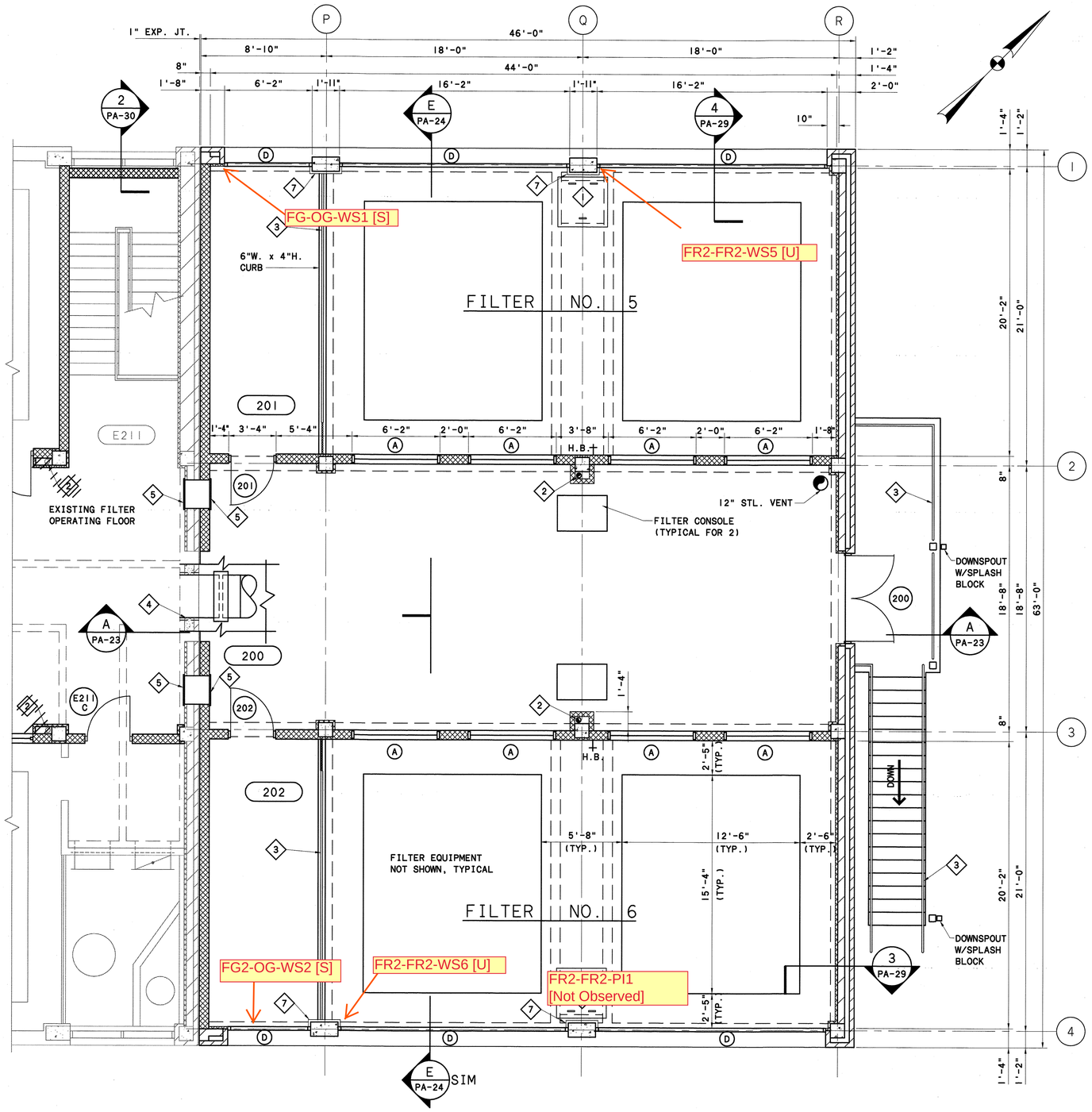
NOTE
ROOF PLAN DOES NOT SHOW ALL ROOF PENETRATIONS, PIPING AND EQUIPMENT. GENERAL CONTRACTOR SHALL LOCATE AND COORDINATE ALL ROOF RELATED ITEMS WITH THE PLUMBING, HVAC, AND ELECTRICAL CONTRACTORS.

7. GLAZED TILE TO UNDERSIDE OF WINDOW. PROVIDE COPING AT COLUMNS.
6. ~~REMOVE EXISTING ROOFING MATERIAL TO METAL DECK WITHIN CROSS HATCHED AREA. INSTALL NEW SINGLE PLY ROOFING SYSTEM AS SPECIFIED.~~
5. GRILLE. SEE HVAC DRAWINGS FOR DETAILS
4. CORE DRILL EXISTING 1'-4"± CONCRETE & BRICK WALL FOR 36" STEEL FILTER INFLUENT PIPE. SEAL WITH LINK SEAL OR EQUAL.
3. ALUMINUM RAILING (TYPICAL)
2. 4" ROOF DRAIN PIPING ENCLOSED IN 4" GLAZED TILE BLOCK
1. 3'-0"x3'-0" ALUMINUM ACCESS DOOR, BILCO TYPE J OR EQUAL WITH ALUMINUM FIXED LADDER ACCESS. TYP. 2.



TYPICAL EXP. JOINT DETAIL

SCALE: 1 1/2"=1'-0"



FILTER OPERATING FLOOR PLAN

SCALE: 1/4"=1'-0"

REVISED 8-98 AS CONSTRUCTED
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NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

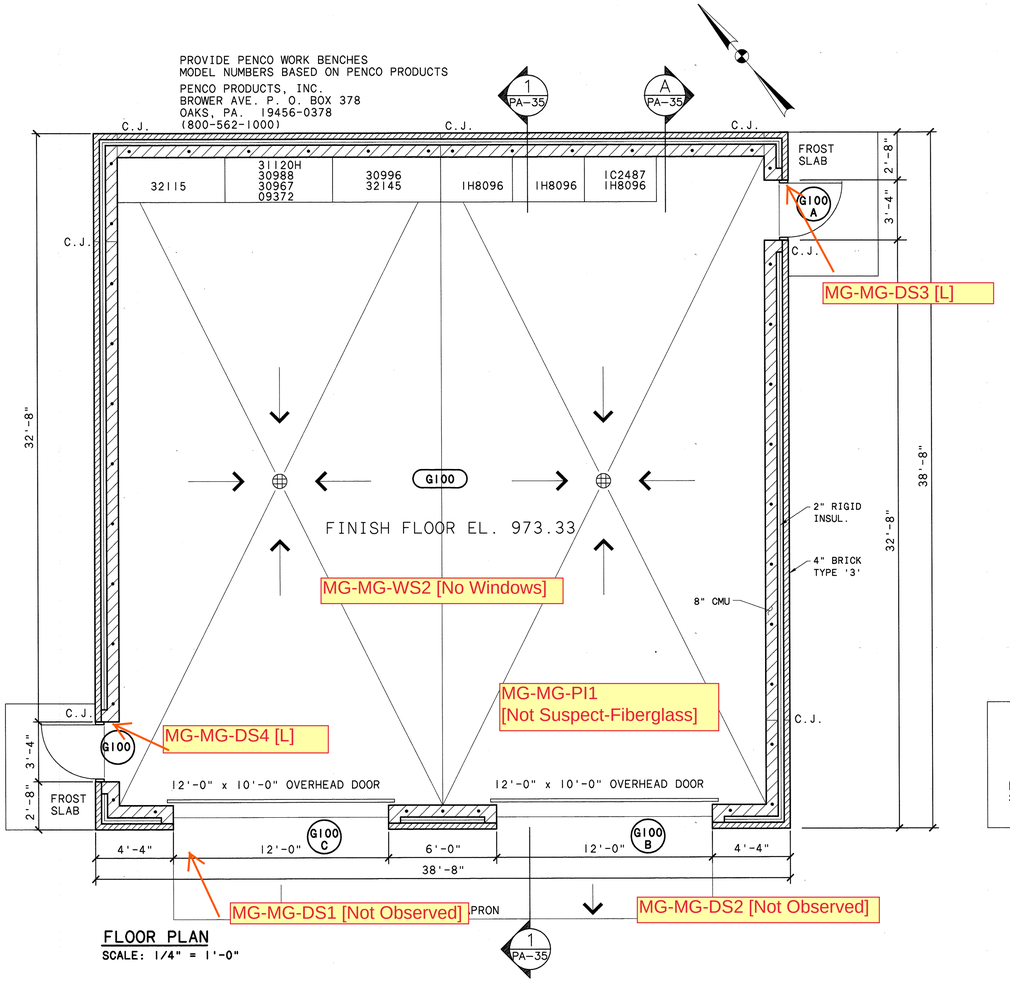
JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	JNV
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

FILTER OPERATING FLOOR AND ROOF PLANS

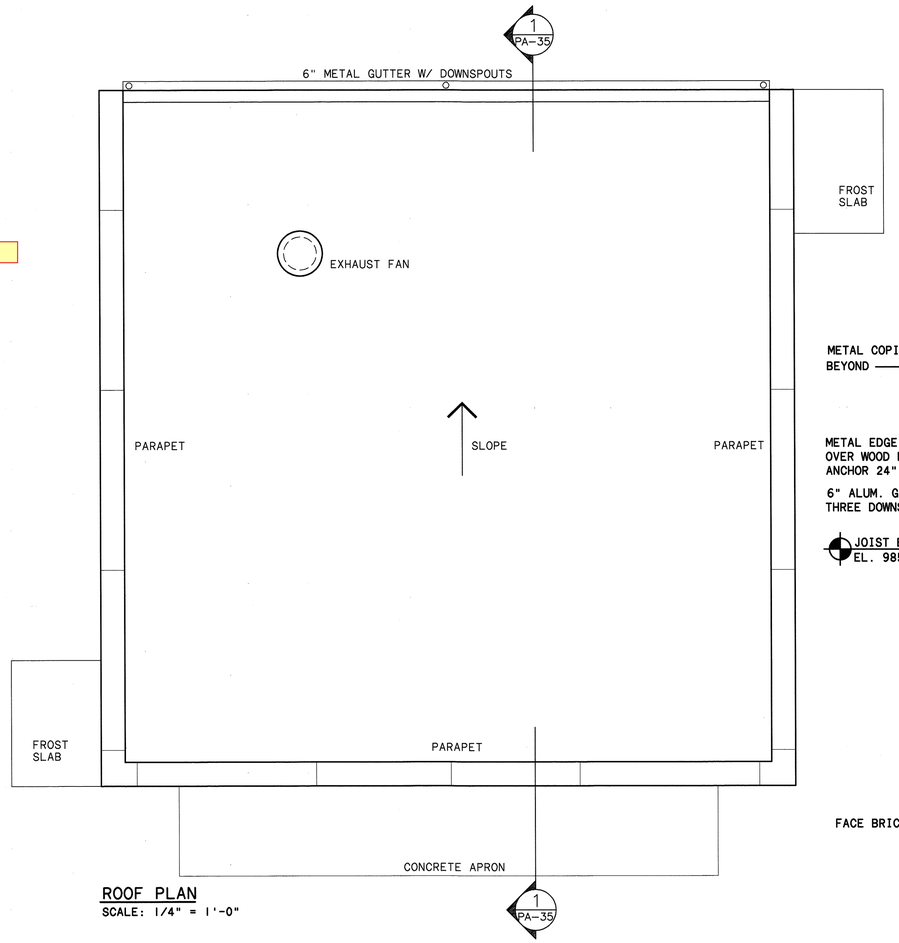
SCALE: AS NOTED
SHEET: PA-22

PROVIDE PENCO WORK BENCHES
MODEL NUMBERS BASED ON PENCO PRODUCTS

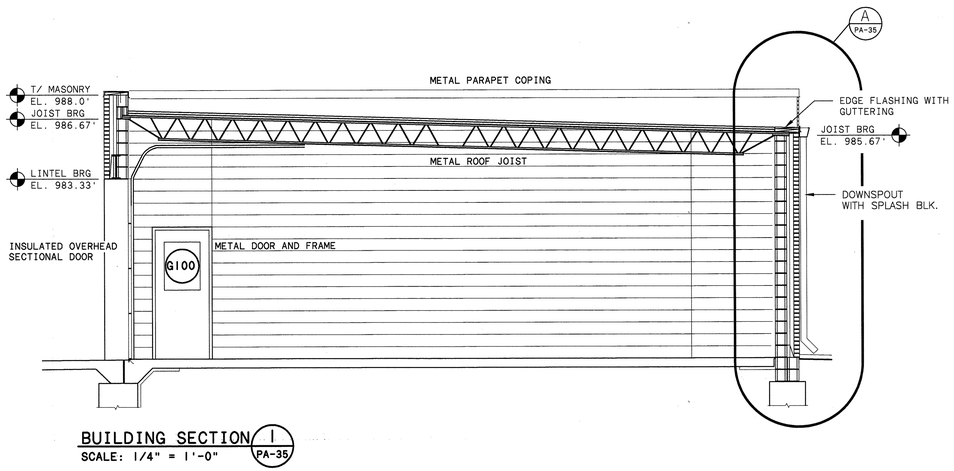
PENCO PRODUCTS, INC.
BROWER AVE. P. O. BOX 378
OAKS, PA. 19456-0378
(800-562-1000)



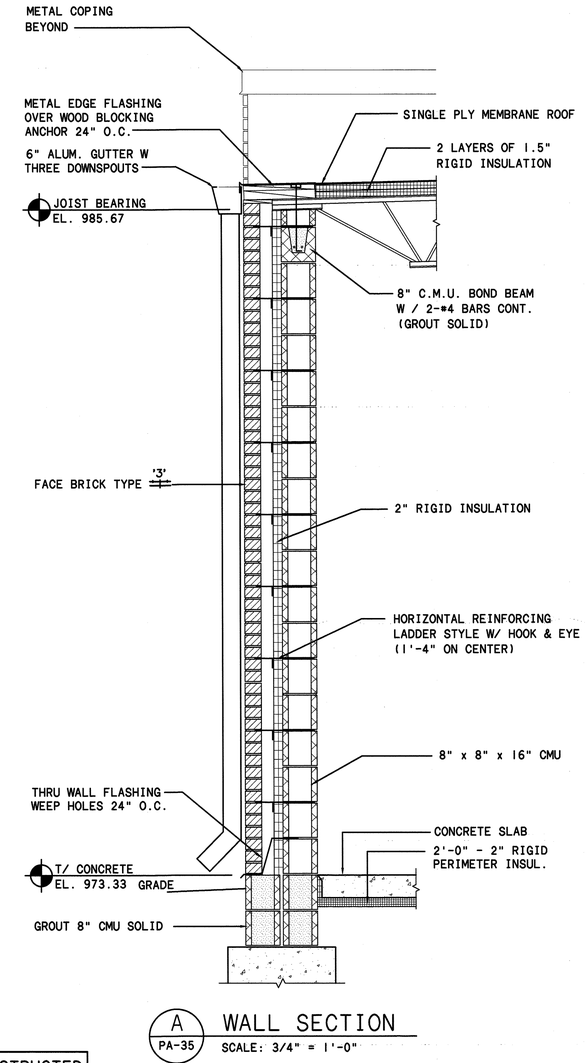
FLOOR PLAN
SCALE: 1/4" = 1'-0"



ROOF PLAN
SCALE: 1/4" = 1'-0"



BUILDING SECTION 1/PA-35
SCALE: 1/4" = 1'-0"



A PA-35 WALL SECTION
SCALE: 3/4" = 1'-0"

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	ASW
DRAWN BY:	JNV
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

GARAGE FLOOR AND ROOF PLANS
BUILDING SECTION

SCALE: AS NOTED
SHEET: PA-35
44 OF 104
Page 1845 of 1978

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BOILER EQUIPMENT ROOM

E106 + FF EL. 972.00

E110

E107

E112

FILTER NO. 2

CL-CL-DS3 [O]

CL-CL-DS4 [N]

FL-FL-DS1 [P]

FL-FL-DS2 [P]

CL-CL-DS2 [O]

OBSERVATION ROOM

+ FF EL. 972.00

CL-CL-DS1 [N]

CHLORINATION ROOM

+ FF EL. 972.00

ALL WIRING IN CHEMICAL FEED ROOM SHALL BE WITHIN PVC SCH. 80 CONDUITS. ALL ELECTRICAL JUNCTION BOXES, PULL BOXES, PANELS, ETC. SHALL BE MENA 4X NON METALLIC CONSTRUCTION.

SEE DETAIL 1/129

LT R1301

NEW ULTRASONIC LEVEL TRANSMITTER, TYP OF 2

EXISTING CHEMICAL BULK TANKS

No overhead door identified [initial CL-CL-DS2]

EXISTING RTU-13 WITH NEW PLC. SEE WIRING DIAGRAMS AND DETAILS, SHEET 84.

TO RTU-13 AI-R13

FL-FL-WS1 [No Windows]

LSL

CHLORINE STORAGE ROOM

EXISTING LEVEL SWITCHES TO REMAIN

LSH R1306 / LSH R1307

EXISTING CHEMICAL DAY TANK

FLUORIDE BUILDING

+ FF EL. 969.67

+ FF EL. 972.00

EXISTING CHLORINE GAS ALARM PANEL. (ACTUAL LOCATION NOT SHOWN.)

1

NEW WEIGHT INDICATOR/ TRANSMITTER,

WIT R1303

3

LT R1302

J

TO RTU-13 AI-R1303

TO RTU-13 AI-R1302

EXISTING CHLORINE GAS VACUUM SWITCH. (ACTUAL LOCATION NOT SHOWN.)

VAS R1309

2

EXISTING CHEMICAL FEED PUMPS STARTERS

CL-CL-WS1 [M]

CL-CL-WS2 [M]

1 3/4" C. WITH 2 #14 TO RTU-13 (DI-R1308)

2 3/4" C. WITH 2 #14 TO RTU-13 (DI-1309)

3 3/4" C. WITH 4 #14 TO RTU-13 (DO-R1311, R1312)

smr Engineering, PC
Electrical, Instrumentation & Control Systems Design
1595 E. Georgetown Rd.
Hudson, Ohio 44236
Phone 330/342-0597 *Fax* 330/342-0852

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Inc. PAINESVILLE, OHIO

BURGESS & NIPLE

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
WATER TREATMENT PLANT UPGRADES
CONTRACT 2006-33

JOB NO.	PR42826
DESIGNED BY:	SMR
DRAWN BY:	XXX
CHECKED BY:	SMR
APPROVED BY:	SMR
DATE:	MARCH 2007

SUGARCREEK WTP
CHLORINE ROOM AND FLUORIDE BUILDING
FIRST FLOOR PLAN

SCALE: 1/4"=1'-0"

SHEET NO. 54 OF 132

EA GROUP
Environmental Analysis and Management

APPENDIX C

City of Canton Sugar Creek Lead Paint Test Locations

City of Canton Sugar Creek Water Treatment Plant
9520 Dolphin Road, SW, (State Route 212, 9 miles west of Bolivar, OH)
Strasburg, OH (Tuscarawas County)

Item	ID #	Level /Location	Description	Color	Lead Result
See sheet		**Main Bldg. - 1st & 2nd Floor**			
MB2	OO-P1	2nd Floor Operator & Lab	Metal Partition - Paint	Light Brown	< 61
MB2	CR-P2	2nd Floor Control Rm	Metal Partition - Paint	Light Brown	370
MB2	CR-P3	2nd Floor Control Rm Doors	Doorway to Lobby-Door	Gray	< 25
MB2	CR-P4	2nd Floor Control Rm Doors	Doorway to Lobby - Frame	Gray	1,140 †
MB1	PG-P5	1st Floor - Filter Pipe Galley	Fan Housing Paint (on Rear wall of Lobby	Gray	404
MB1	PG-P6	1st Floor - Pipe Galley	Piping - Makeup Water to Reservoir	Blue	1,550 †
MB1	PG-P7	1st Floor - Pipe Galley	Piping - Surface Wash to Filters	Blue	876 †
MB1	PG-P8	1st Floor - Pipe Galley	Piping - Door Frame to HS Pump Room	Blue	< 25
MB1	PG-P9	1st Floor - Pipe Galley	Piping - Potable City Water	Blue	1,540 †
MB1	PG-P10	1st Floor - Pipe Galley	Piping - Door Frame to Elec Room	Blue	< 25
MB1	EL- PI4	1nd Floor - Entrance Lobby	Piping Insulation - Fin Tube Heater		

See sheet		**Filter Gallery 1st Floor - Lower Level**			
FG1	LL-P1	36"Pipe Header Lower Level	Paint Sample Raw Water Header at Filter 2	Blue	< 25
FG1	LL-P2	24" Backwash Supply	Paint Sample Backwash Header at Filter 2	Blue	< 25
FG1	LL-P3	24" Effluent Drain	Paint Sample Surface W Header at Filter 2	Beige	< 25
FG1	LL-P4	8" Filter to Waste Drain	Paint Sample F-T-W at Filter 2	Blue	< 25
FG1	LL-P5	36"Pipe Header Lower Level	Paint Sample Raw Water Header at Filter 6	Blue	< 25
FG1	LL-P6	24" Backwash Supply	Paint Sample Backwash Header at Filter 6	Blue	< 25
FG1	LL-P7	8" Surface Washwater	Paint Sample Surface W Header at Filter 6	Blue	< 25
FG1	LL-P8	36" Raw Water Influent	Paint Sample F-T-W at Filter 4/6	Blue	< 25
FG1	LL-P9	24" Effluent Drain	Paint Sample Surface W Header at Filter 6	Beige	< 96

See sheet		**Filter Gallery - 2nd Floor Operator Gallery**			
FG2	OG-P1	Skylight in Operator Hall	Steel Frame	White	114

See sheet		**Filter Room - Original Filters #1,#2, #3, #4 and New Filters #3 and #6**			
FR2	FR2-P1	Filter Room - Old North	Handrail Pipe support around Filter #2	Light Green	< 68
FR2	FR2-P2	Filter Room - New South	Handrail Pipe support around Filter #6	Light Green	350

See sheet		**High Service Pump Room**			
HSP	P2-P1	High Service Pump Room	Pump #2 - Motor Housing	Dark Gray	140
HSP	P2-P2	High Service Pump Room	Pump #2 - Pump Casing Discharge Elbow	Green	< 110
HSP	P2-P3	High Service Pump Room	Pump #**2** - Cone Check Valve	Blue	410
HSP	P2-P4	High Service Pump Room	Pump #2 -Discharge Elbow at Floor	Blue	140
HSP	P3-P5	High Service Pump Room	Pump #3 - Motor Housing	Dark Gray	44
HSP	P3-P6	High Service Pump Room	Pump #3 - Pump Casing Discharge Elbow	Green	89
HSP	P3-P7	High Service Pump Room	Pump #**3** Cone Check Valve	Blue	2,200 †
HSP	P3-P8	High Service Pump Room	Pump #3 Discharge Elbow at Floor	Blue	41.5
HSP	P4-P9	High Service Pump Room	Pump #4 - Motor Housing	Dark Gray	< 64
HSP	P4-P10	High Service Pump Room	Pump #**4** - Cone Check Valve	Green	1,200 †
HSP	P4-P11	High Service Pump Room	Pump #4 - Discharge Elbow at Floor	Blue	67.8
HSP	MP-P12	High Service Pump Room	Makeup Reservoir Pump (N.) Motor	Green	< 25
HSP	MP-P13	High Service Pump Room	Makeup Reservoir Pump (N.)Casing	Green	3,010 †
HSP	MP-P13	High Service Pump Room	Makeup Reservoir Pump (N.)Discharge Pipe		

City of Canton Sugar Creek Water Treatment Plant
9520 Dolphin Road, SW, (State Route 212, 9 miles west of Bolivar, OH)
Strasburg, OH (Tuscarawas County)

Item	ID #	Level /Location	Description	Color	Lead Result
See sheet		**High Service Pump Room**			
HSP	ST- P14	High Service Pump Room	Spiral Metal Handrail	Light Green	11,400 ‡
HSP	ST- P15	High Service Pump Room	Spiral Metal Tread	Light Green	4,900 †
HSP	HV-P16	High Service Pump Room	Air Intake ductwork on West wall		
HSP	SC-P17	High Service Pump Room	Building Steel Column North Wall @ Center	Beige	1,410 †
HSP	SC-P18	High Service Pump Room	Building Steel Column South Wall@ Center	Beige	1,660 †
HSP	DR-P19	High Service Pump Room	Door Frame to Electrical Room	Gray	200
HSP	DR-P20	High Service Pump Room	Door Middle Tri-fold Door to Electrical Room	Gray	1,700 †
See sheet		**Main WTP - Electrical Room**			
EL	ER - P1	First Floor - Elec. Room	MCC Cabinet	Gray	360
EL	ER - P2	First Floor - Screen Bldg. -	Main Power Distribution Panel (East Side)	Gray	1,000 †
EL	ER - P3	First Floor - Screen Bldg. -	Main Power Distribution Panel (East Side)	Gray	< 96
EL	ER - P4	First Floor - Screen Bldg. -	Main Painted Ductwork	Beige	< 110
See sheet		**Wellfield - Well # 1-10**			
WF	W2- P1	Well Casing #2	42" Pump Casing	Gray	29,400 ‡
WF	W2- P2	Well #2 Discharge Pipe	12" Discharge Pipe	Green	390
WF	W2- P3	Well #2 Motors	Housing of Electric Motor	Gray	160
WF	W2 - P7	Well #2 Vertical I- Beam	Steel I- Beam	Gray/ Blue	2040 †
WF	W4 - P4	Well Casing # 4	42" Pump Casing	Gray	310
WF	W4 - P5	Well # 4 Discharge Pipe	12" Discharge Pipe	Green	2,400 †
WF	W4 - P6	Well #4 Motors	Housing of Electric Motor	Gray	10,400 ‡
WF	W9 - P8	Well Casing #9	42" Pump Casing	Green	22,000 ‡
WF	W9 - P9	Well #9 Discharge Pipe	12" Discharge Pipe	Green	226
WF	W9 - P10	Well #9 Motors	Housing of Electric Motor	Gray	200
WF	W9 - P11	Electrical Panel - # 9	Door of Electrical Panels at each Well	Gray	< 61
Spare	W9 - P12	Electrical Panel - # 9	Door of Electrical Panel	Gray	152
See sheet		**Aerator Bldg - West Larger Unit**			
AW	AW-R1	Roof - Screen Bldg.	Core Sample of Roof Insulation - 2/3 Point		
AW	AW-B2	Building -Fence Screen	Aerator - East Side		
AW	AW-B3	Building -Fence Screen	Aerator - West Side		
AW	AW-P1	24"Pipe Header Lower Level	Paint Sample Main Header	Black	210
AW	AW-P2	Valve Stand Operator	Paint Sample Valve Operator	Black/Gray	58
See sheet		**Aerator Bldg - East Smaller Unit**			
AE	AE-B2	Building -Fence Screen	Aerator - East Side		
AE	AE-B3	Building -Fence Screen	Aerator - West Side		
AE	AE-P1	24"Pipe Header Lower Level	Paint Sample Main Header	Black/Gray	1,100 †
AE	AE-P2	Valve Stand Operator	Paint Sample Valve Operator	Black/Gray	< 71
See sheet		**Maintenance Garage**			
MG	MF-P1	Ductwork	Paint Sample		
MG	MG-PI1	Pipe Insulation	Pipe Insulation		
sheet MPS -26		**Chlorination and Cylinder Storage Rooms**			
CL	CL-P1	Chlorination Room	Door Frame	Gray	< 25
CL	CL-P2	Chorine Cylinder Room	Monorail Beam Paint	Gray	5,420 ‡

City of Canton Sugar Creek Water Treatment Plant
9520 Dolphin Road, SW, (State Route 212, 9 miles west of Bolivar, OH)
Strasburg, OH (Tuscarawas County)

Item	ID #	Level /Location	Description	Color	Lead Result
See sheet		**Fluoridation Building**			
FL	FL-P1	Safety Shower	Safety Shower Pipe	Blue	< 25
FL	FL-P2	Sump Pump Base Plate	Sump Pump Base Plate	Gray	< 28
FL	FL-P3	Handrail	Handrail	Gray	< 25

Results expressed in milligrams per kilogram (mg/kg).
‡ = Lead-based paint as defined by U.S. EPA (>5000 mg/kg)
† = Lead-containing paint as defined by Consumer Product Safety Act (>600 mg/kg)

[OSHA regulates potential exposure to any detectable level of lead]

Grayed items either not required or unpainted; no associated samples

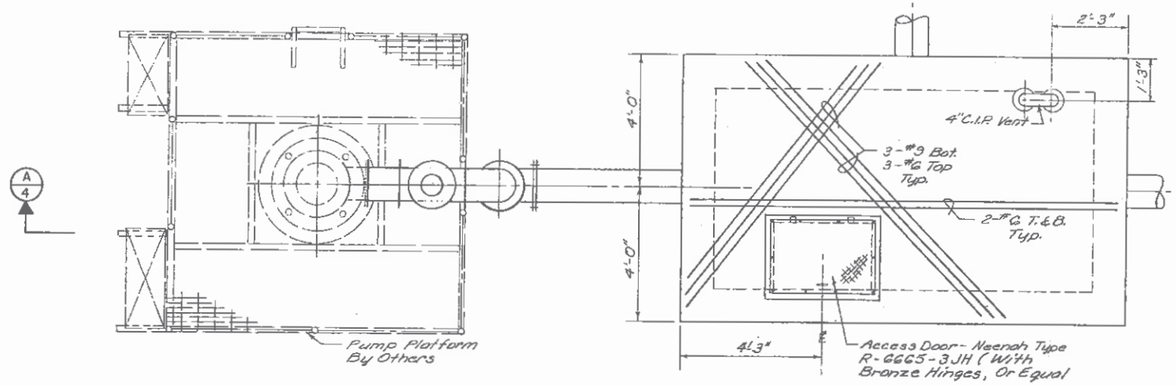
WELL #2

W2-P1

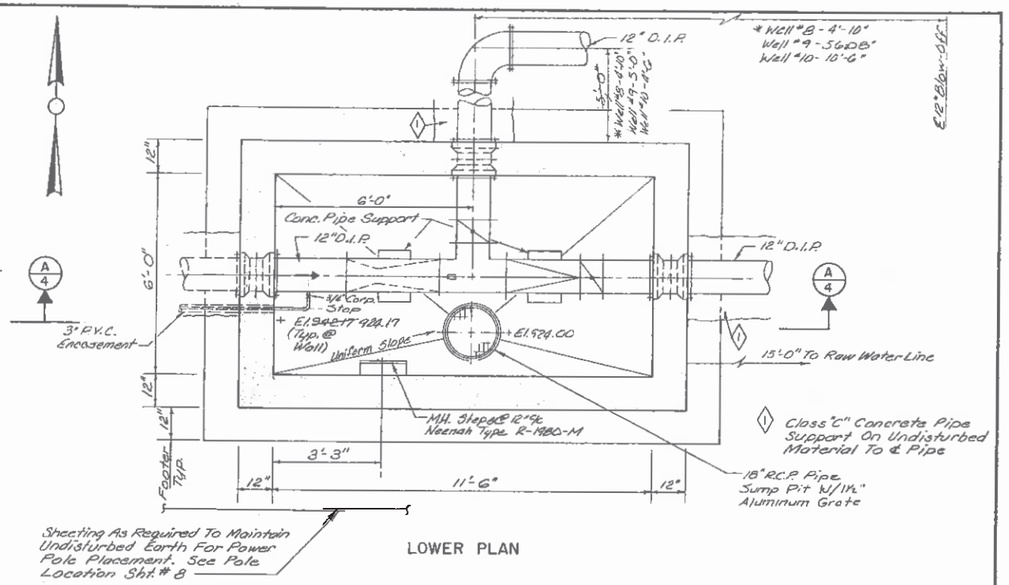
W2-P3

W2-P7

W2-P2



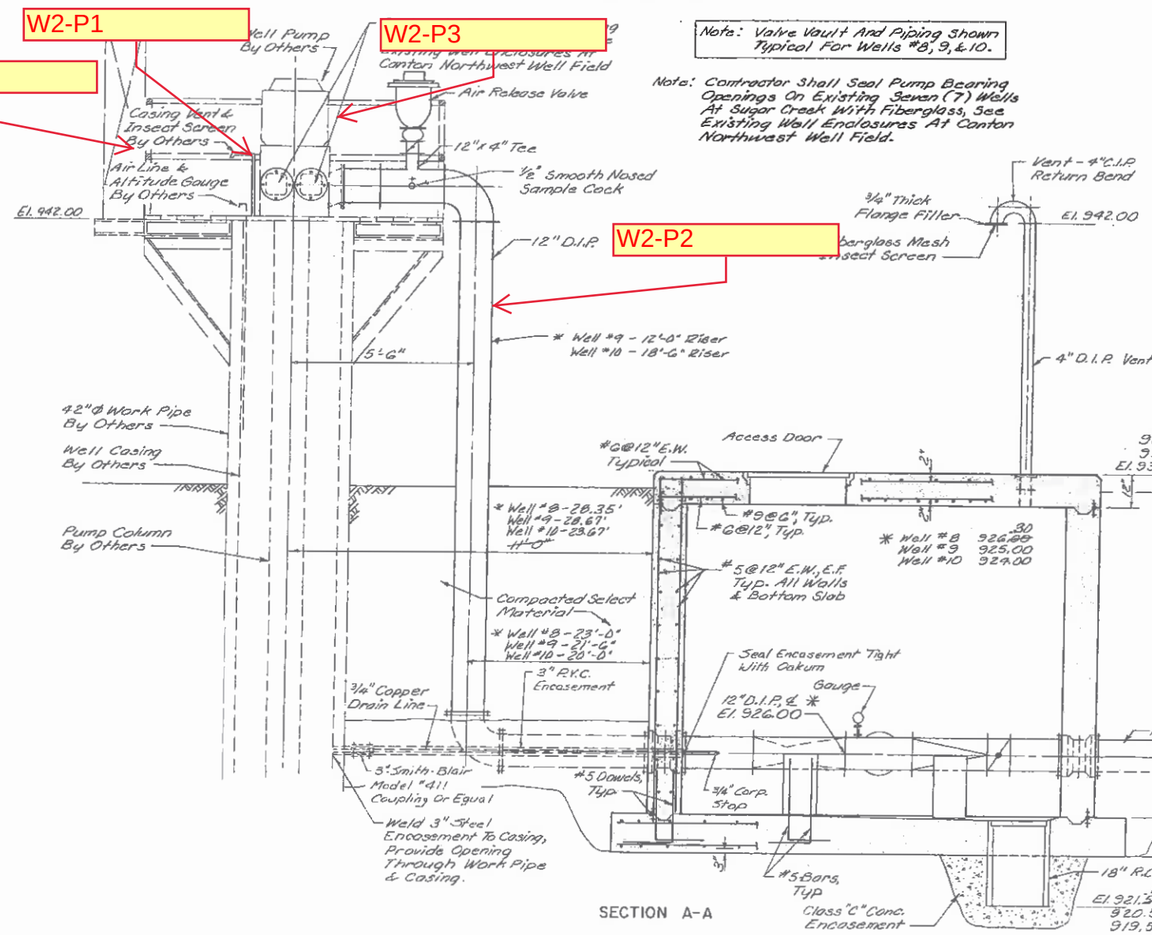
UPPER PLAN



LOWER PLAN

Note: Valve Vault And Piping Shown Typical For Wells #8, 9, & 10.

Note: Contractor Shall Seal Pump Bearing Openings On Existing Seven (7) Wells At Sugar Creek With Fiberglass, See Existing Well Enclosures At Canton Northwest Well Field.

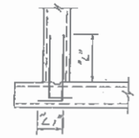


SECTION A-A

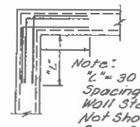
STANDARD LEGEND

- Flanged Wall Pipe Tapped For Studs
- M.J. Wall Pipe Tapped For Studs
- Butterfly Valve
- Check Valve
- Flanged Pipe
- Mechanical Joint Pipe
- Flow Meter
- Cut Class "A" Concrete
- Cut Class "C" Concrete
- Proposed Grade Slope
- Existing Grade Slope

1. "L" = 30 Bar Dia. (Unless Noted).
2. "L" Shall Be A Min. Of 20 Bar Diameter (Unless Noted).



TYPICAL WALL FOOTING
NO SCALE

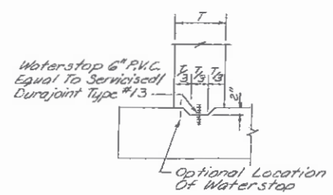


Note: "L" = 30 Bar Dia. Size And Spacing Same As Horiz. Wall Steel. Vertical Reinf. Not Shown. Horiz. Corner Bars Shall Be Used In Walls Of All Structures Unless Noted Otherwise.

TYPICAL HORIZONTAL WALL CORNER BAR DETAIL
NO SCALE

GENERAL NOTES

1. STANDARD DETAILS & NOTES APPLY TO ALL STRUCTURES & BUILDINGS, UNLESS OTHERWISE NOTED.
2. ALL NON-REENTRANT CORNERS OF EXPOSED CONCRETE SLABS & WALLS HAVE 1" x 45° CHAMFERS.
3. SEE SPECIFICATIONS FOR CLEARANCES FOR ALL REINFORCING BARS.
4. IN ALL TWO-WAY SOLID SLABS PLACE SHORT SPAN BARS CLOSEST TO THE SURFACE OF THE CONCRETE. TEMPERATURE STEEL SHALL BE PLACED FURTHEST FROM THE SURFACE OF THE CONCRETE, UNLESS OTHERWISE NOTED.
5. ALL REINFORCING STEEL SPLICES & LAPS SHALL BE 30 BAR DIA. AND NOT LESS THAN 12", UNLESS OTHERWISE NOTED.
6. NO HORIZONTAL JOINTS SHALL BE MADE IN SLABS OR BEAMS. CONSTRUCTION JOINTS REQUESTED BY THE CONTRACTOR & NOT INDICATED ON THE DRAWINGS MUST BE APPROVED BY THE ENGINEER.
7. ALL ALUMINUM IN CONTACT WITH CONCRETE OR DISSIMILAR METALS SHALL BE COATED WITH TWO (2) COATS OF BITUMASTIC.

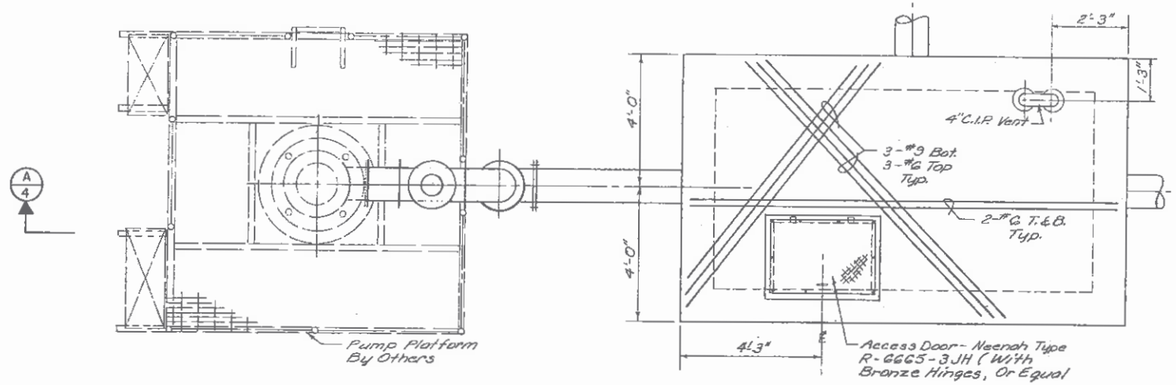


TYPICAL CONSTRUCTION JOINT DETAIL
NO SCALE

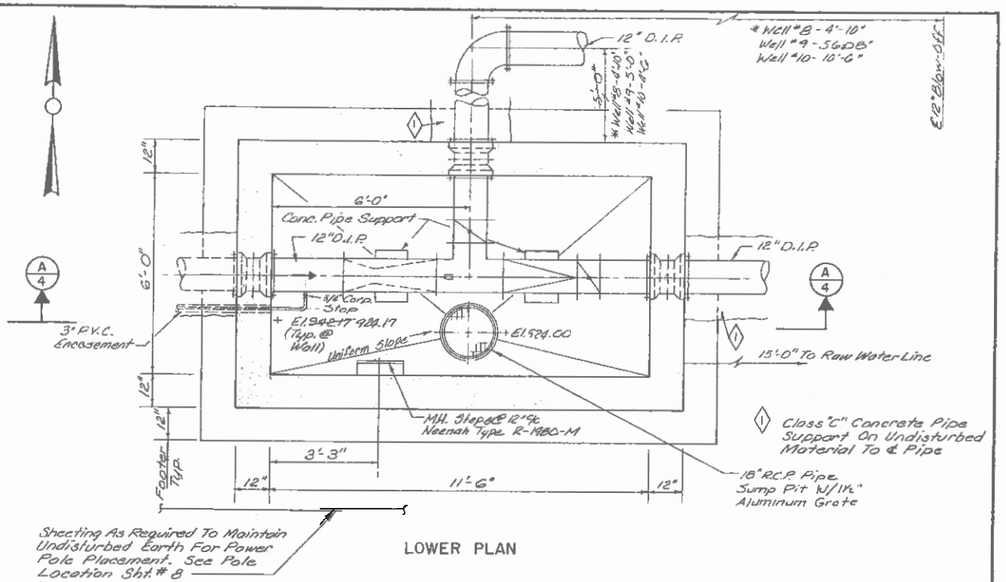
EXHIBIT 3-3

BURGESS & NIPLE, LIMITED COLUMBUS, OHIO	CONSULTING ENGINEERS MENTOR, OHIO	CANTON, OHIO WATERWORKS IMPROVEMENTS SUGAR CREEK WELL FIELD	TRACED BY H.S. DRAWN BY H.S. CHECKED BY J.P.A. APPROVED BY	REVISIONS Sump, Door, Drain 3/19/79 J.P.A. Vault Elevations 6-21-79 J.P.A.	SCALE 1/2"=1'-0" UNLESS NOTED JOB NO. 8571 DATE DEC. 1978	VALVE VAULT AND DETAILS	SHT. NO. 4 / 9

WELL #4



UPPER PLAN

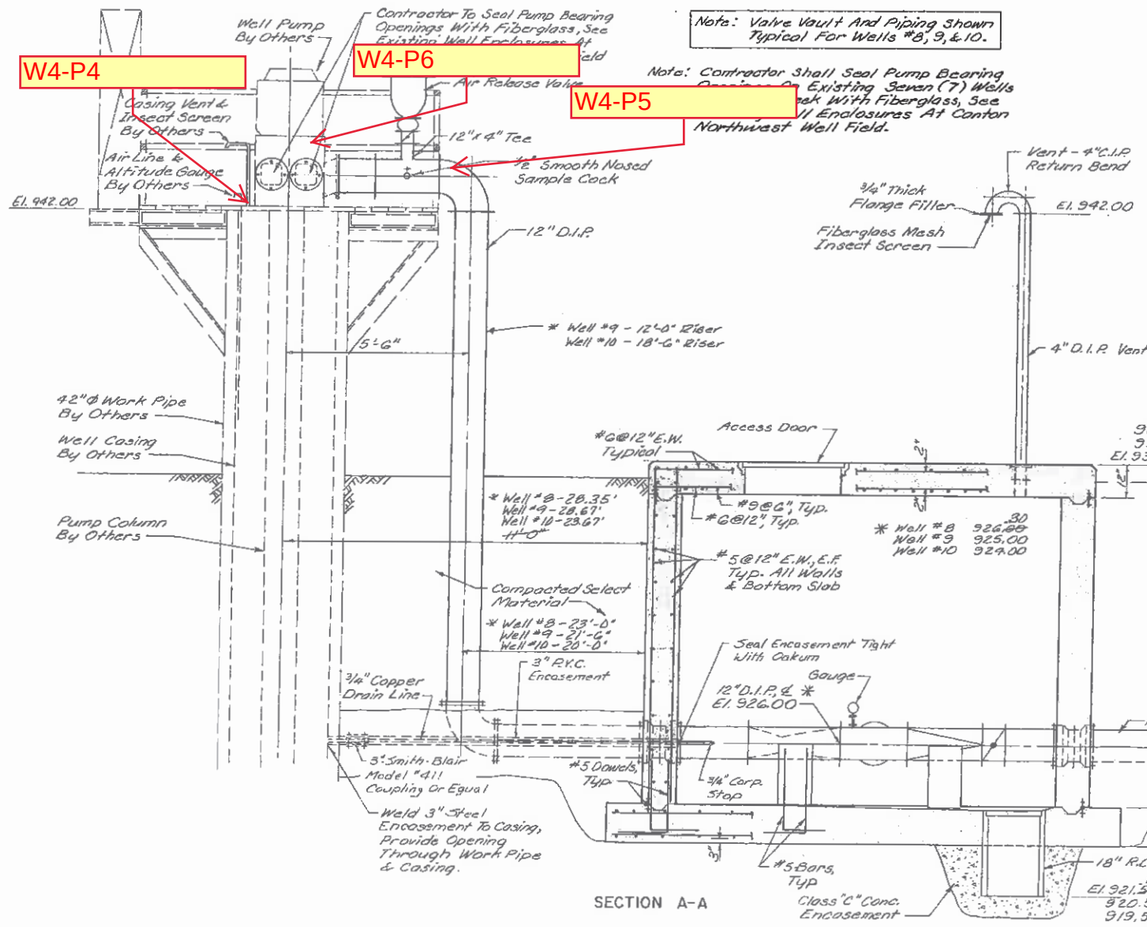


LOWER PLAN

W4-P4

W4-P6

W4-P5



SECTION A-A

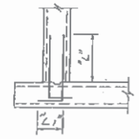
Note: Valve Vault And Piping Shown Typical For Wells #8, 9, & 10.

Note: Contractor Shall Seal Pump Bearing ... Existing Seven (7) Wells ... With Fiberglass, See ... Enclosures At Canton Northwest Well Field.

STANDARD LEGEND

- Flanged Wall Pipe Tapped For Studs
- M.J. Wall Pipe Tapped For Studs
- Butterfly Valve
- Check Valve
- Flanged Pipe
- Mechanical Joint Pipe
- Flow Meter
- Cut Class "A" Concrete
- Cut Class "C" Concrete
- Proposed Grade Slope
- Existing Grade Slope

1. "Z" = 30 Bar Dia. (Unless Noted).
2. "L" Shall Be A Min. Of 20 Bar Diameter (Unless Noted).



TYPICAL WALL FOOTING
NO SCALE

TYPICAL HORIZONTAL WALL CORNER BAR DETAIL
NO SCALE

GENERAL NOTES

1. STANDARD DETAILS & NOTES APPLY TO ALL STRUCTURES & BUILDINGS, UNLESS OTHERWISE NOTED.
2. ALL NON-REENTRANT CORNERS OF EXPOSED CONCRETE SLABS & WALLS HAVE 1" x 45° CHAMFERS.
3. SEE SPECIFICATIONS FOR CLEARANCES FOR ALL REINFORCING BARS.
4. IN ALL TWO-WAY SOLID SLABS PLACE SHORT SPAN BARS CLOSEST TO THE SURFACE OF THE CONCRETE. TEMPERATURE STEEL SHALL BE PLACED FURTHEST FROM THE SURFACE OF THE CONCRETE, UNLESS OTHERWISE NOTED.
5. ALL REINFORCING STEEL SPLICES & LAPS SHALL BE 30 BAR DIA. AND NOT LESS THAN 12", UNLESS OTHERWISE NOTED.
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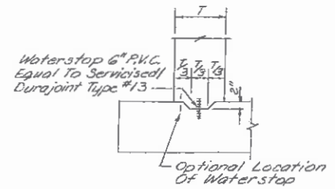


TYPICAL CONSTRUCTION JOINT DETAIL
NO SCALE

EXHIBIT 3-3

BURGESS & NIPLE, LIMITED COLUMBUS, OHIO	CONSULTING ENGINEERS MENTOR, OHIO	CANTON, OHIO WATERWORKS IMPROVEMENTS SUGAR CREEK WELL FIELD	TRACED BY H.S. DRAWN BY H.S. CHECKED BY J.P.A. APPROVED BY	REVISIONS Sump, Door, Drain 2/9/79 J.P.A. Vault Elevations 6-21-79 J.P.A.	SCALE 1/2"=1'-0" UNLESS NOTED JOB NO. 8571 DATE DEC. 1978	VALVE VAULT AND DETAILS	SHEET NO. 4 9

WELL #9

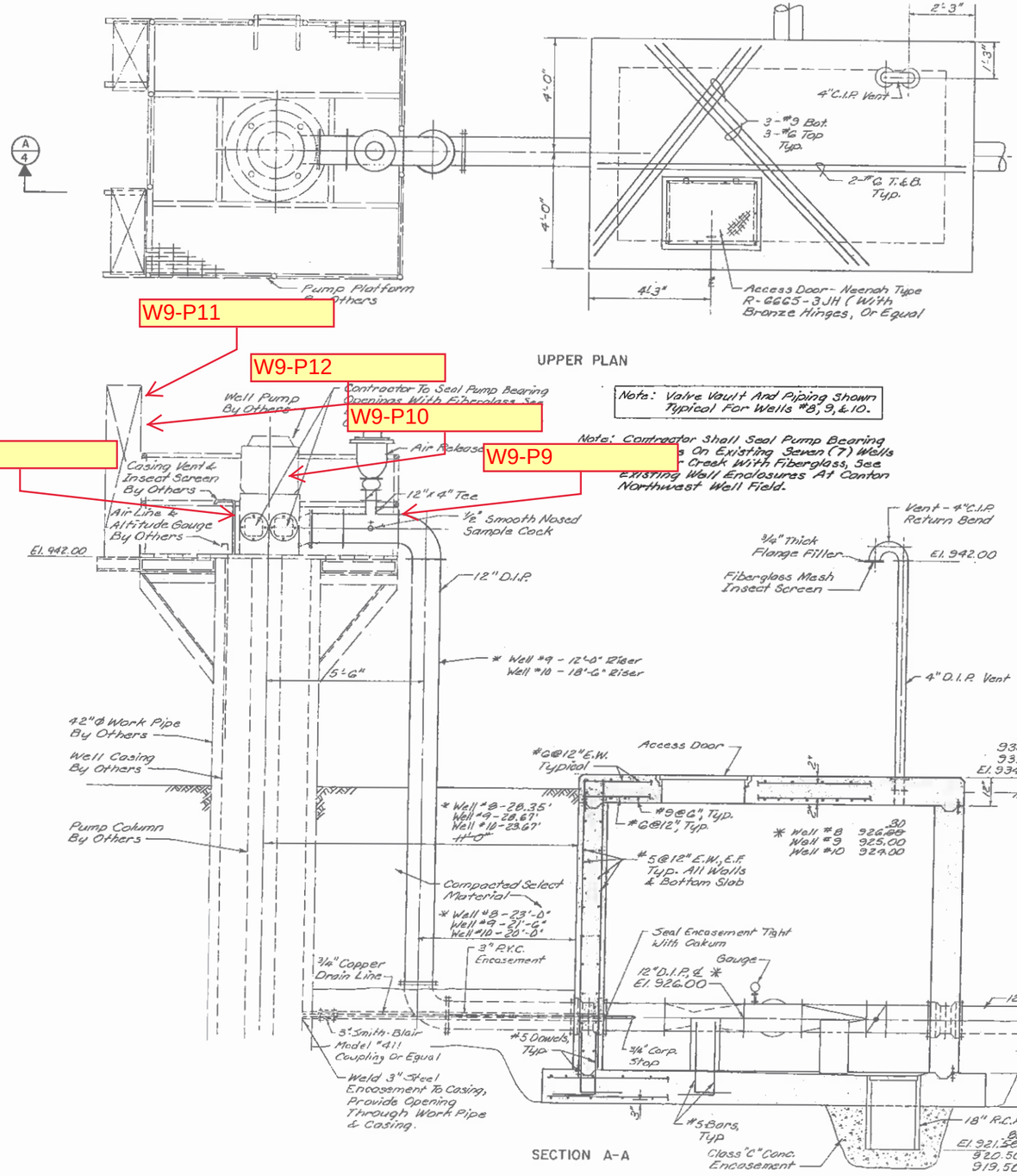
W9-P11

W9-P12

W9-P10

W9-P8

W9-P9

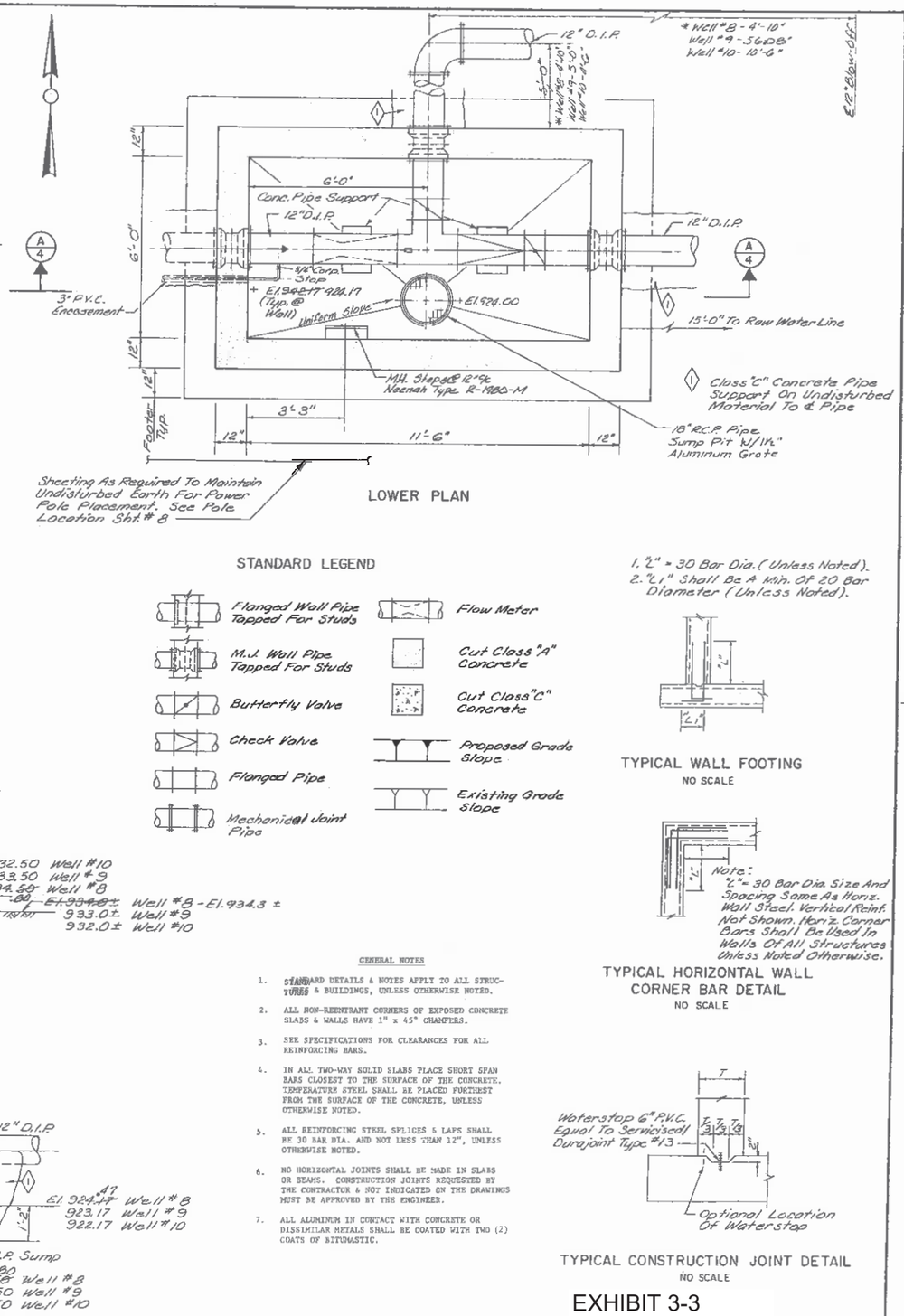


SECTION A-A

UPPER PLAN

Note: Valve Vault And Piping Shown Typical For Wells #8, 9, & 10.

Note: Contractor Shall Seal Pump Bearing Openings On Existing Seven (7) Wells At Sugar Creek With Fiberglass, See Existing Well Enclosures At Canton Northwest Well Field.



LOWER PLAN

STANDARD LEGEND

- Flanged Wall Pipe Tapped For Studs
- M.J. Wall Pipe Tapped For Studs
- Butterfly Valve
- Check Valve
- Flanged Pipe
- Mechanical Joint Pipe
- Flow Meter
- Cut Class "A" Concrete
- Cut Class "C" Concrete
- Proposed Grade Slope
- Existing Grade Slope

1. "Z" = 30 Bar Dia. (Unless Noted).
2. "L" Shall Be A Min. Of 20 Bar Diameter (Unless Noted).

TYPICAL WALL FOOTING
NO SCALE

TYPICAL HORIZONTAL WALL CORNER BAR DETAIL
NO SCALE

GENERAL NOTES

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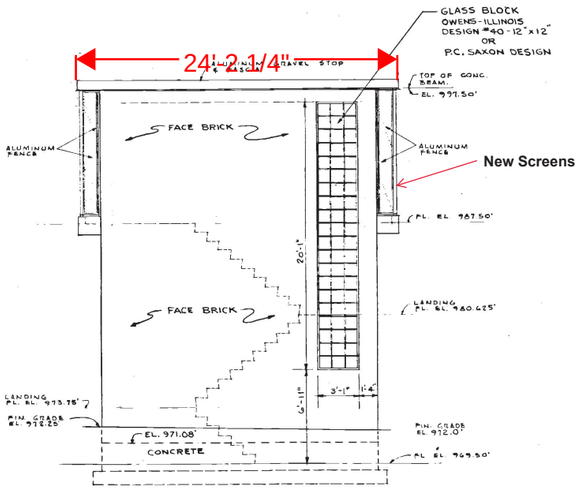
TYPICAL CONSTRUCTION JOINT DETAIL
NO SCALE

EXHIBIT 3-3

BURGESS & NIPLE, LIMITED COLUMBUS, OHIO	CONSULTING ENGINEERS MENTOR, OHIO	CANTON, OHIO WATERWORKS IMPROVEMENTS SUGAR CREEK WELL FIELD	TRACED BY H.S. DRAWN BY H.S. CHECKED BY J.P.A. APPROVED BY	REVISIONS Sump, Door, Drain 2/9/79 J.P.A. Vault Elevations 6-21-79 J.P.A.	SCALE 1/2"=1'-0" UNLESS NOTED JOB NO. 8571 DATE DEC. 1978	VALVE VAULT AND DETAILS	SHEET NO. 4 9

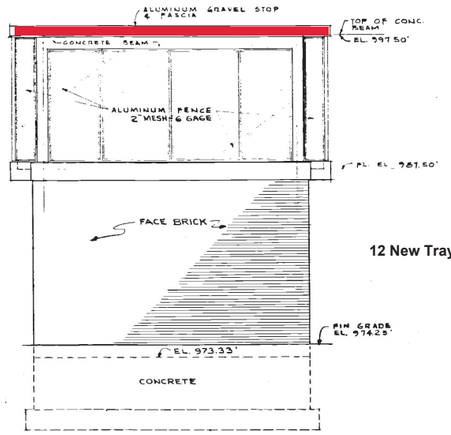
WEST AERATOR



NORTH ELEVATION

SCALE 3/16" = 1'-0"

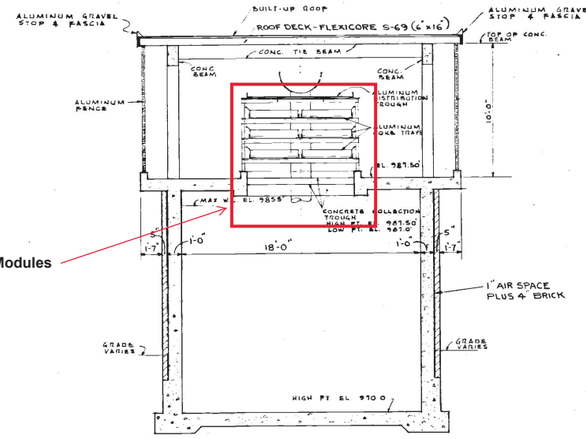
New Roof Planks and Single-Ply Roofing



SOUTH ELEVATION

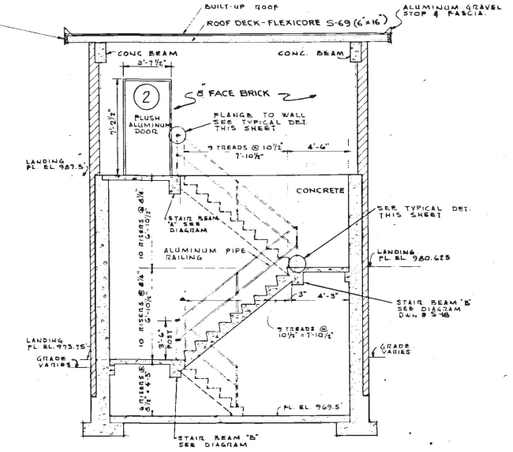
SCALE 3/16" = 1'-0"

12 New Tray Modules



SECTION "A-A"

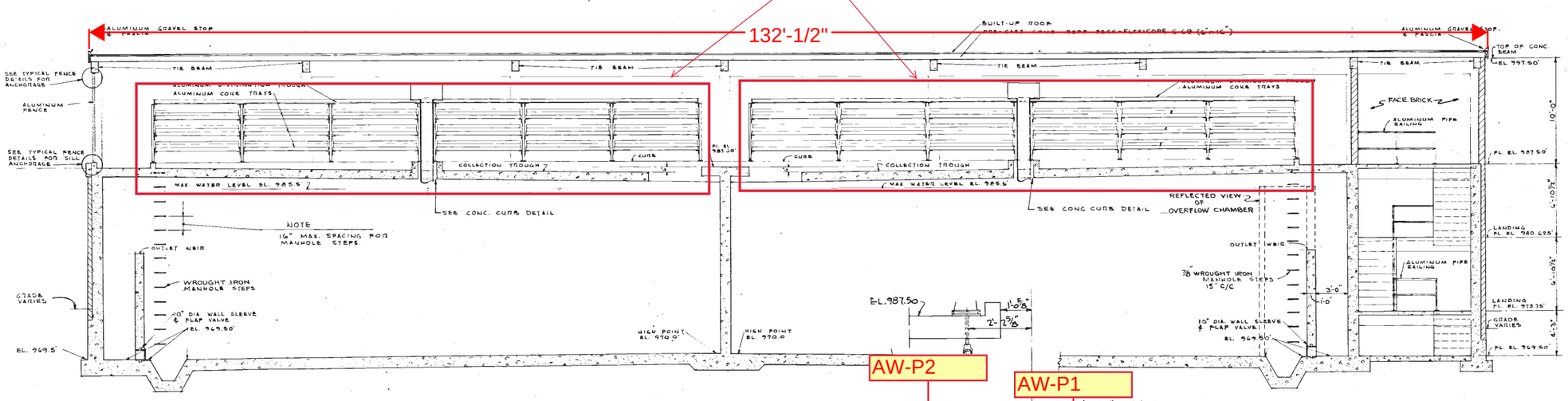
SCALE 3/16" = 1'-0"

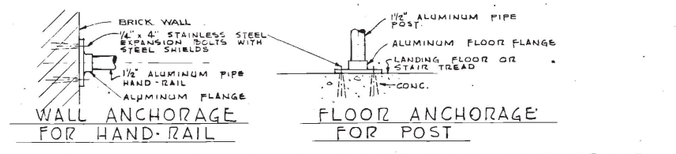


SECTION "B-B"

SCALE 3/16" = 1'-0"

12 New Tray Modules



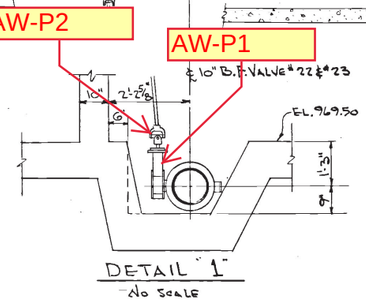


TYPICAL DETAILS - HAND-RAIL ANCHORAGE

NO SCALE

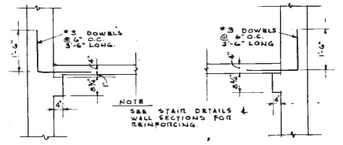
SECTION "C-C"

SCALE 3/16" = 1'-0"



DETAIL "1"

No Scale

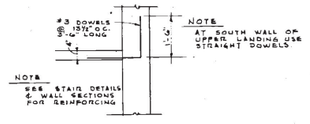


TYP. LANDING CONN. @ EAST WALL.

SCALE 3/8" = 1'-0"

TYP. LANDING CONN @ WEST WALL.

SCALE 3/8" = 1'-0"



TYP LANDING CONN. @ NORTH & SOUTH STAIR WALLS.

SCALE 3/8" = 1'-0"

4-11-61	C.W.L. Revised

CITY OF CANTON, OHIO

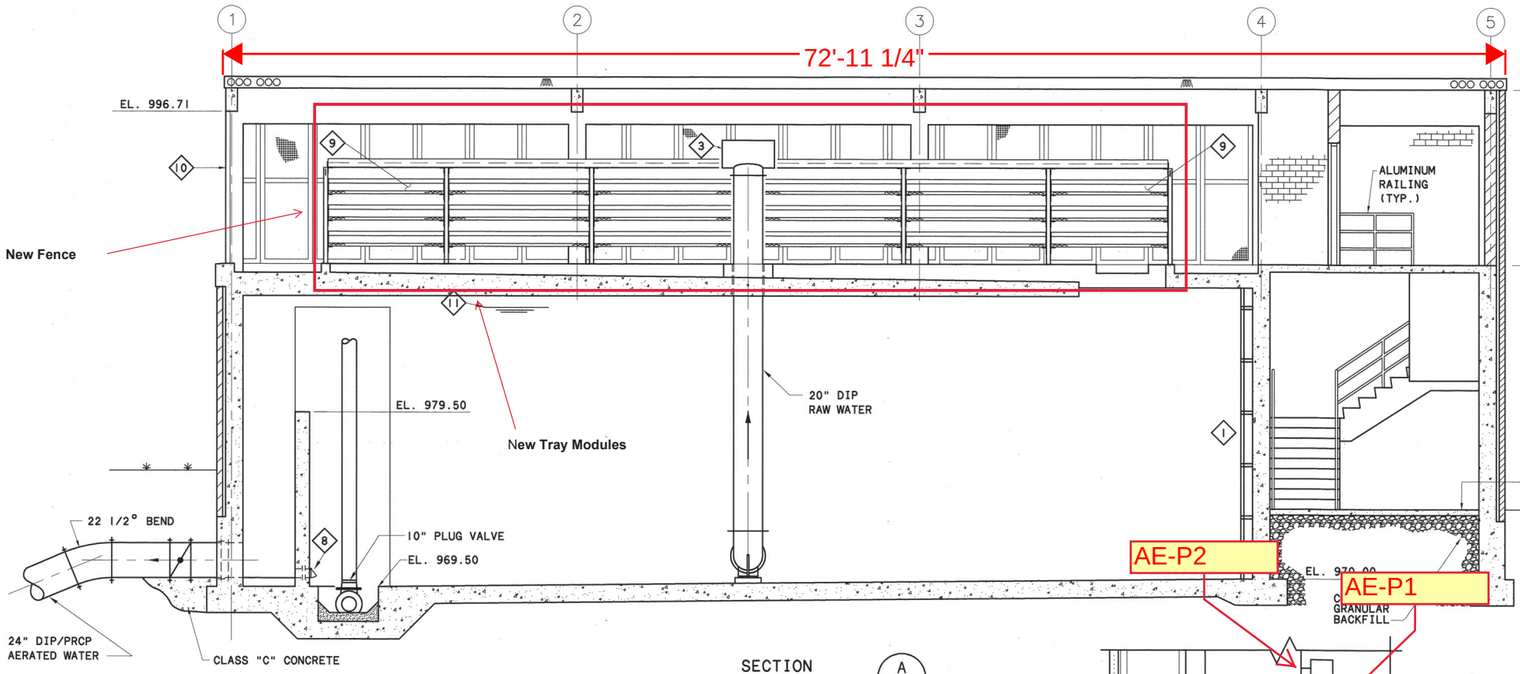
DEPARTMENT OF PUBLIC SERVICE - WATER WORKS DEPT.

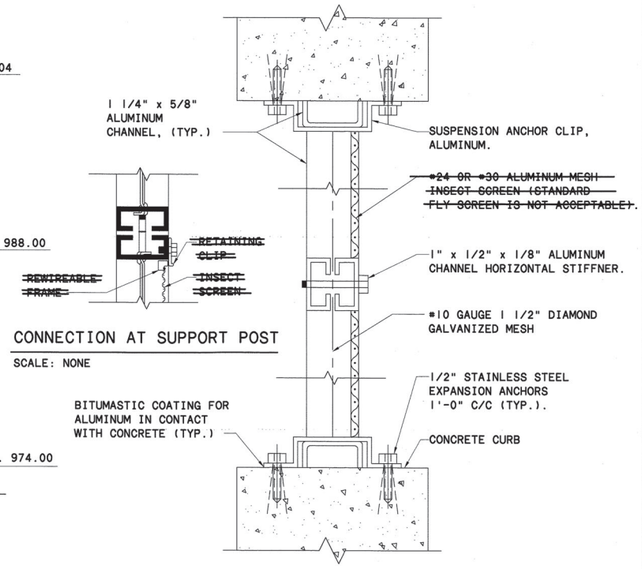
BEISWENGER, HOCH, & ASSOCIATES
CONSULTING ENGINEERS
AKRON, OHIO

Exhibit 34-5Aeartor (Weat)

AERATOR SECTIONS

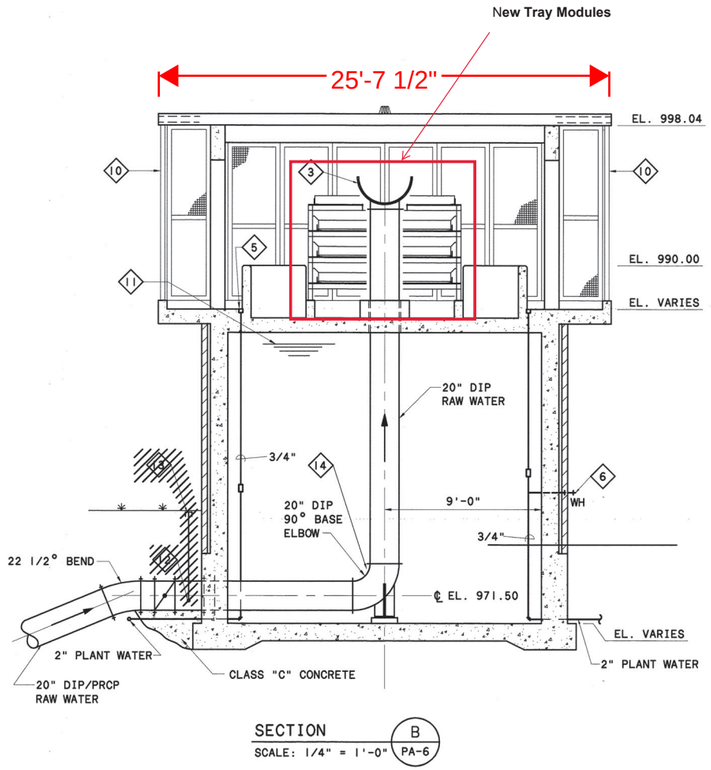
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	DRAWING NO.
J M	L E A		J T H	J T H	10-15-59	S-17-1



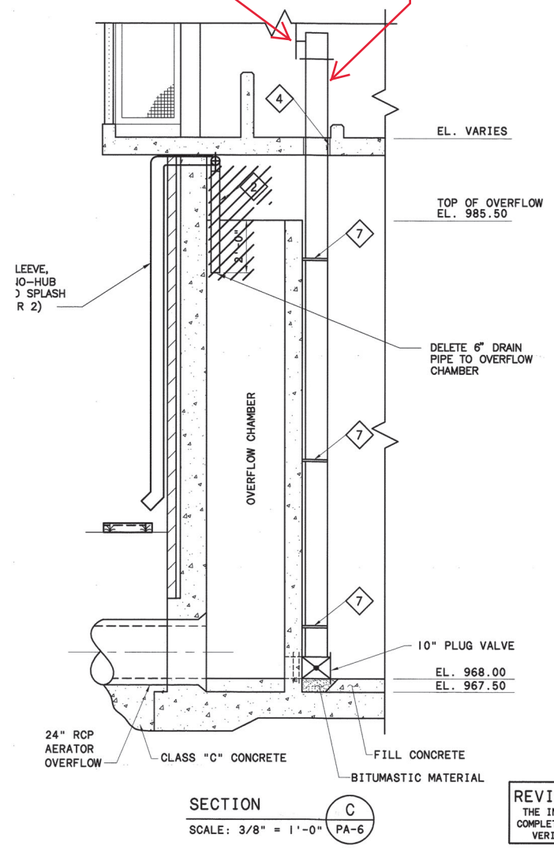


CONNECTION AT SUPPORT POST
SCALE: NONE

INSECT SCREEN DETAIL
SCALE: NONE



SECTION
SCALE: 1/4" = 1'-0"
B
PA-6



SECTION
SCALE: 3/8" = 1'-0"
C
PA-6

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

14 PROVIDE 1 1/2 INCH TAP AND CORPORATION STOP ON 20 INCH DIP 90 DEGREE RAW WATER PIPE BASE ELBO

~~13 3" PLUG VALVE WITH OPERATING NUT AND VALVE BOX, SET FLUSH FINAL GRADE.~~

~~12 3" TAP IN DIP.~~

11 MAXIMUM WATER LEVEL EL. 985.50

10 ~~INSECT~~ SCREEN, SEE THIS SHEET FOR DETAILS.

9 SEE SHT. PA-8 FOR AERATION TRAY AND SUPPORT STRUCTURE DETAILS

8 6" FLAP VALVE

7 SUPPORT BRACKETS FOR BONNET PER VALVE MANUFACTURERS RECOMMENDATIONS

6 WALL HYDRANT BY PLUMBING CONTRACTOR. LOCATE 3' ABOVE FINISHED GRADE.

5 BOX HYDRANT BY PLUMBING CONTRACTOR.

4 SEAL AROUND BONNET WITH LINK SEAL OR EQUAL.

3 1/2 SECTION OF 36" DIA. GALV. STL. PIPE 3'-0" LONG.

2 6" DRAIN PIPING

1 FIXED FIBERGLASS SAFETY LADDER

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	JNV
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

AERATOR BUILDING SECTIONS
Exhibit 4-6 Aerator (East)

SCALE: AS NOTED
PA-7
16 OF 104

P:\PR16162\CADD\PA-7-SC.DWG 8-12-98 10:30:35 am EST

SC-P17
P2-P4
P3-P8
P4-P11
ST-P15
ST-P14
P2-P3
P3-P7
P4-P10
MP-P12
P2-P2
P3-P6
P4-P9
MP-P13
P2-P1
P3-P5
DR-P19
SC-P18
ER-P1
DR-P20
ER-P4
ER-P3
ER-P2

REPLACE GLASS WINDOW WALL TINTED THERMOPANE WINDOWS WITH ALUMNUM MULLIONS

REPLACE EX. 16" CHECK & BUTTERFLY VALVE (TYP. 5)

REMOVE EXISTING DUCTOWRK AND CUT IN NEW OPENING FOR OVERHEAD DOOR

NEW 12' W X 12' H OVERHEAD COILING DOOR

4' HIGH CONCRETE PAD (TO BE REMOVED AND FLOOR TILED)

REBUILD EX. PUMP BASE WITH SCH. 80 ELBOW. REMOVE AND REBUILD PUMP ROTATING PARTS

REBUILD OR REPLACE EX. SYNCHRONOUS MOTORS

NEW OVERHEAD COILING DOOR WITH FIRELI

FROST SLABS

12" STL. CLEARWELL VENT

HEADER SECTION NOT REPLACED USED EXISTING

16" STL. PUMP DISCHARGE

24" SCH. 40 BLK STL. HIGH SERVICE PUMP DISCHARGE

2'-6" x 3'-0" ALUMINUM ACCESS DOOR W/"LADDER UP" SAFETY POST AND LOCK, BILCO EQUAL

HOUSE SERVICE PUMP

F.D. (TYP.)

WASH WATER PUMP

Replace with new Backwash Pump w/VFD

EX. INDUCTION MOTOR REPLACE PUMP HEAD. REMOVE AND REBUILD PUMP ROTATING PARTS

PUMP #1
PUMP #2
PUMP #3
PUMP #4
PUMP #5
MH LID

9'-0"

HIGH SERVICE PUMP ROOM
E102

NOTE: REPLACE ALL DAMAGED FLOOR TILE TO MATCH EXISTING.

#6 DOWELS x 2'-8" W/8" MIN. EMBEDMENT, ANCHOR W/HILTI HIT C-100 OR EQUAL, LAP OVER TOP OF OUTSIDE #8 BARS IN BEAM, TYP.

5,746.64 sf

MOTOR STARTERS

NEW ELECTRICAL 5 KV SWITCHGEAR AND MCC W/ VFDS

ELECTRICAL ROOM
E103

NEW FIRE-RATED DOOR

10'x10' OVERHEAD DOOR

NEW OVERHEAD COILING DOOR

GENERATOR
DAY TANK
GE100

SWITCH-GEA
MAIN SWITCHBOARD & TRANSFORM

DEHUMIDIFY AREA BEHIND 1ST FLOOR LOBBY FILTER PIPING GALLERY
E101

NEW MAINTENANCE AND INTRUMENT REPAIR SHOP

STORAGE ROOM
E105

CHEMICAL ROOM
E104

BOILER EQUIPMENT ROOM
E106

MECHANICAL ROOM

NEW ALUMINUM DOORS AND HADWARE
NEW THERMOPANE ALUMINUM WINDOWS

E109
E111
E104 A
E103 A

GRAVEL
_ABS

3'-4" 3'-4"
3'-4"
10'-0"
10'-0"
3'-4"
3'-4"
30'-0"
27'-4"
1'-4"

2'-8" 14'-0" 2'-8"
1'-4" 17'-4" 8"
19'-4" 1" EXP. JOINT

6'-8" 3'-4"

10'-0"
3'-0"
12"
2'-6"

FLOOR PLAN
SCALE: 3/16" = 1'-0"

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

Exhibit 4-15
High Service Pump and Piping Plan

BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

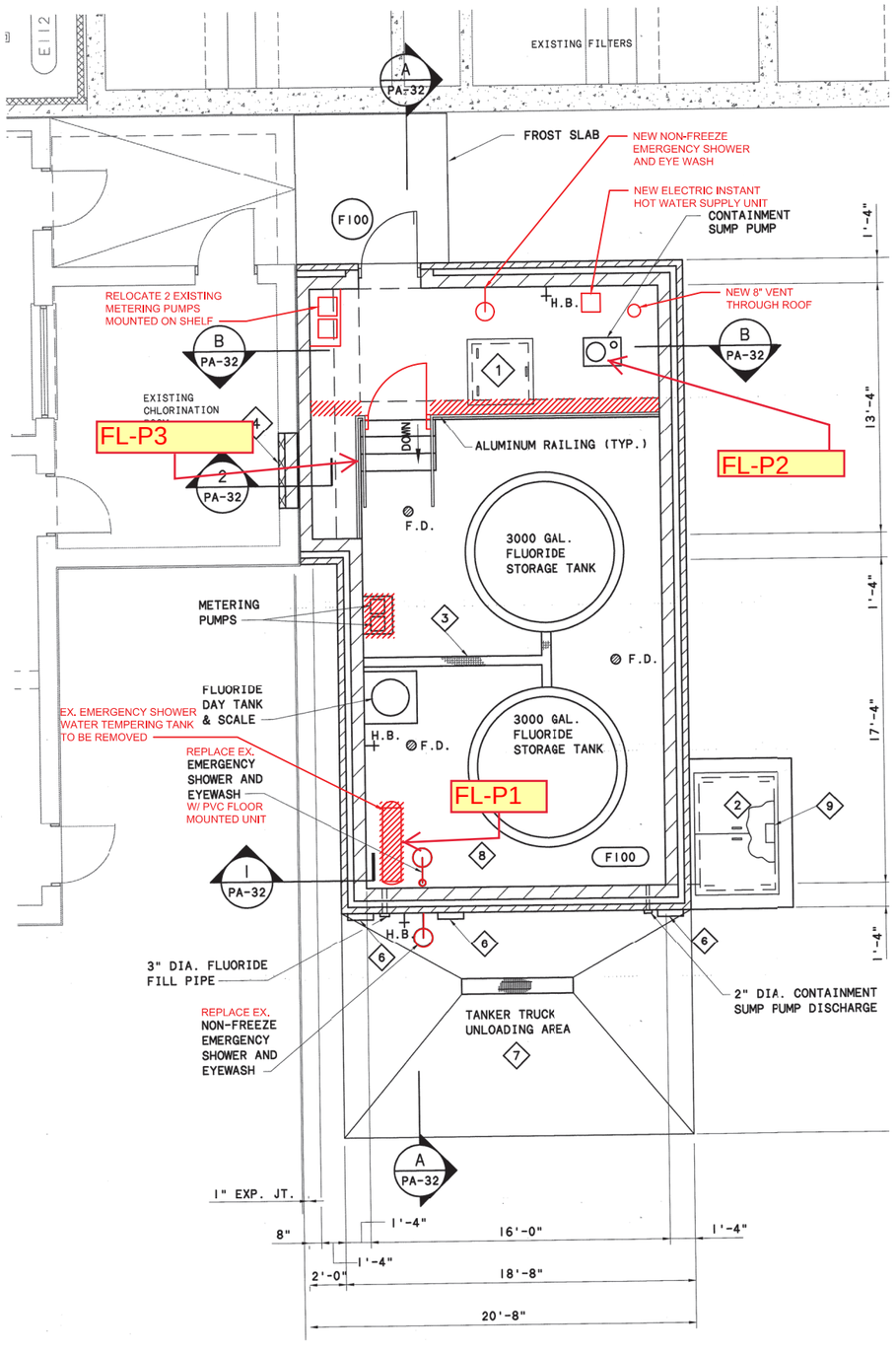
CITY OF CANTON

NO.	DESCRIPTION REVISIONS	DATE

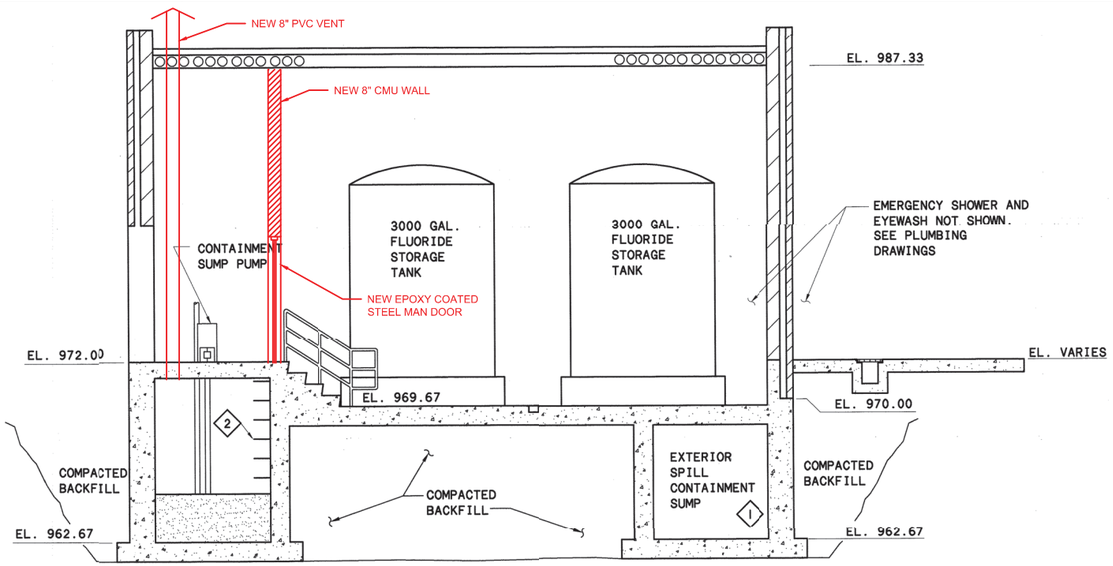
JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
APPROVED BY:	XXX
SCALE:	NONE

PUMP ROOM FLOOR PLAN

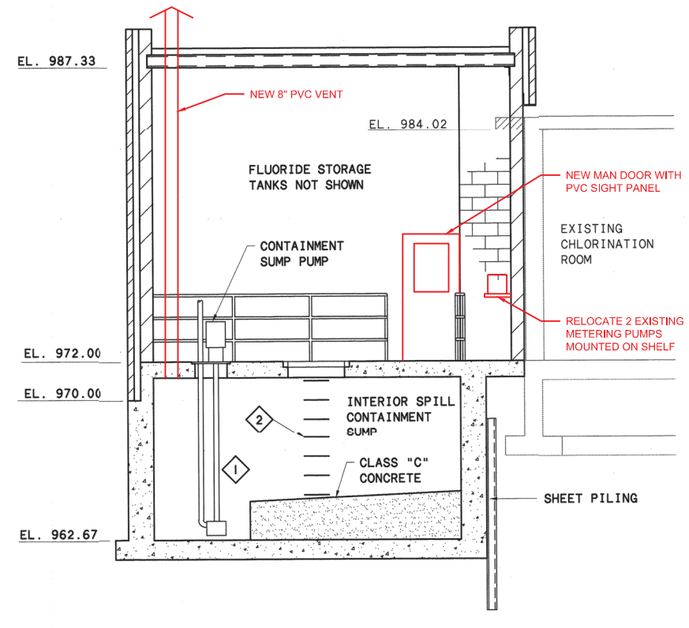
SHEET OF



FLOOR PLAN
SCALE: 1/4" = 1'-0"



SECTION
SCALE: 1/4" = 1'-0" A PA-31



SECTION
SCALE: 1/4" = 1'-0" B PA-31

BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

CITY OF CANTON

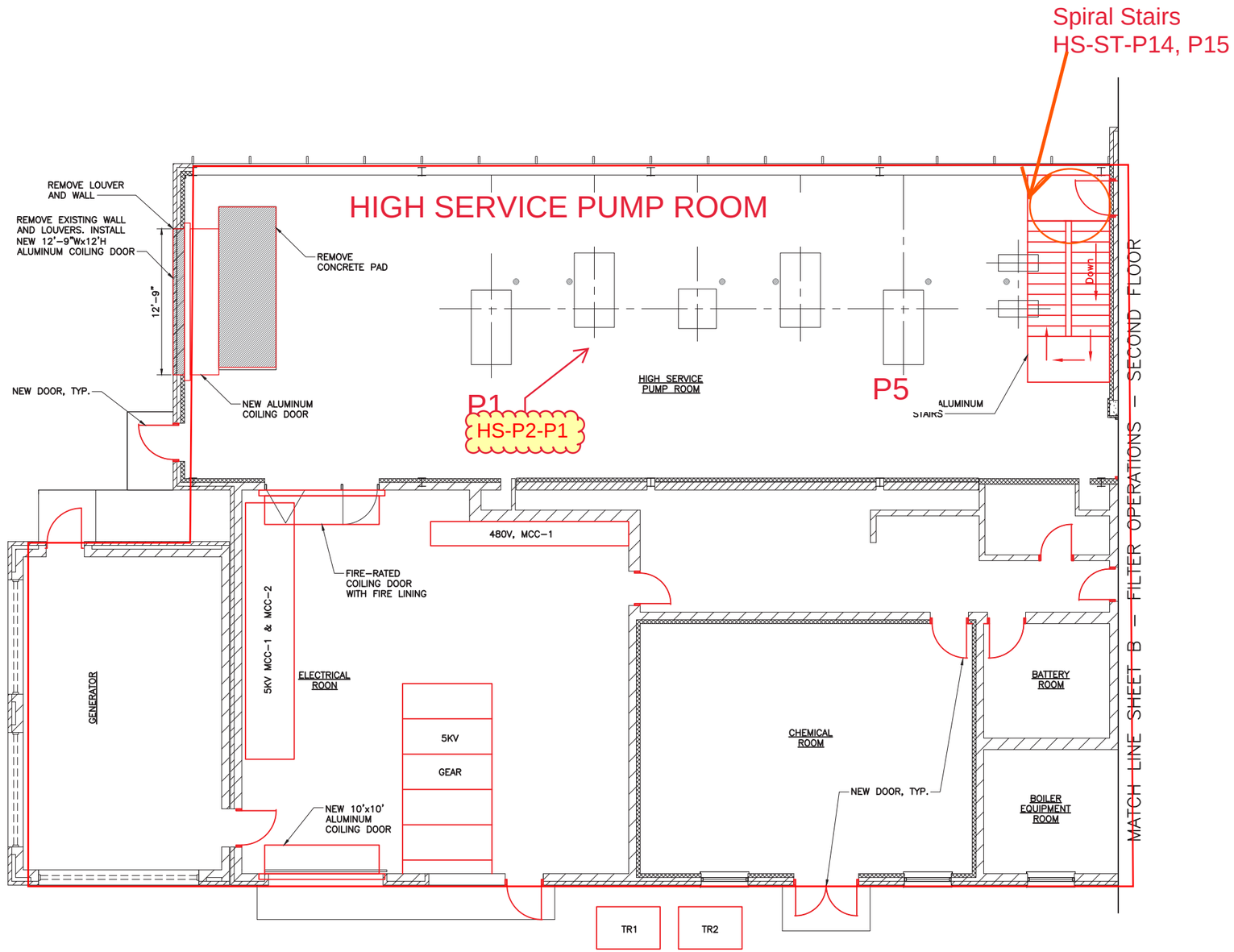
NO.	DESCRIPTION REVISIONS	DATE

JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
APPROVED BY:	XXX
SCALE:	NONE

FLUORIDE BUILDING

SHEET OF

PLOTTED: 9/17/2019 4:06:59 PM



BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

CITY OF CANTON
CAPITAL IMPROVEMENTS PROJECT

NO.	DESCRIPTION	DATE
	REVISIONS	

JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	CMS
DRAWN BY:	KAS
CHECKED BY:	CMS
APPROVED BY:	CMS
SCALE:	3/16"=1'-0"

PUMP ROOM AND GARAGE AREA

A

SHEET 1 OF ----

P:\PR57484\Cadd\Sheets\A PUMP ROOM AND GARAGE AREA.dwg 9/17/2019 2:58:57 PM Kroll, Matthew

Exhibit 4-24 Electrical - Main Swtichgear
Electrical Room Floor Plan

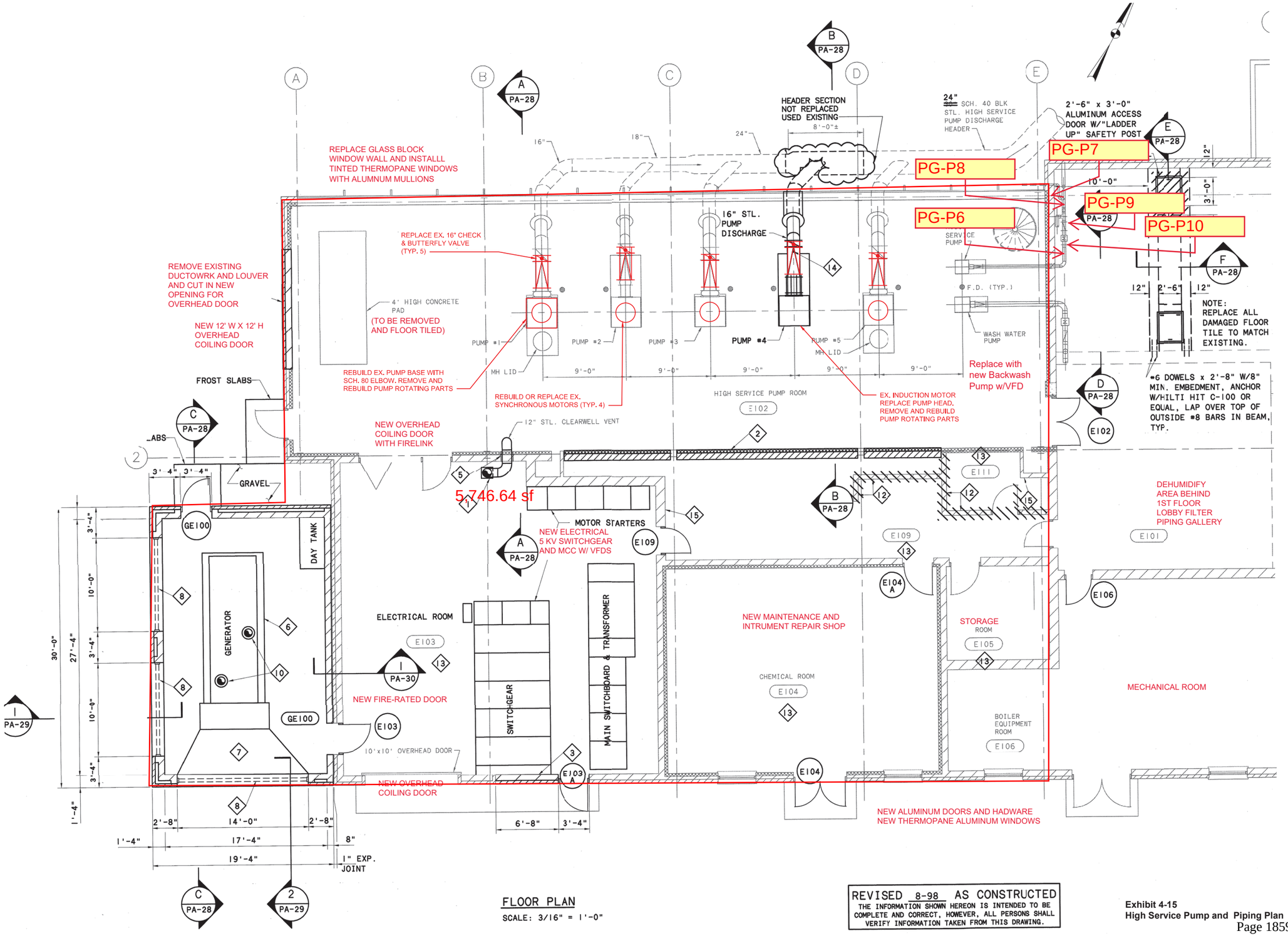


Exhibit 4-15
High Service Pump and Piping Plan

BURGESS & NIPLE
100 WEST ERIE STREET
PAINESVILLE, OHIO 44077

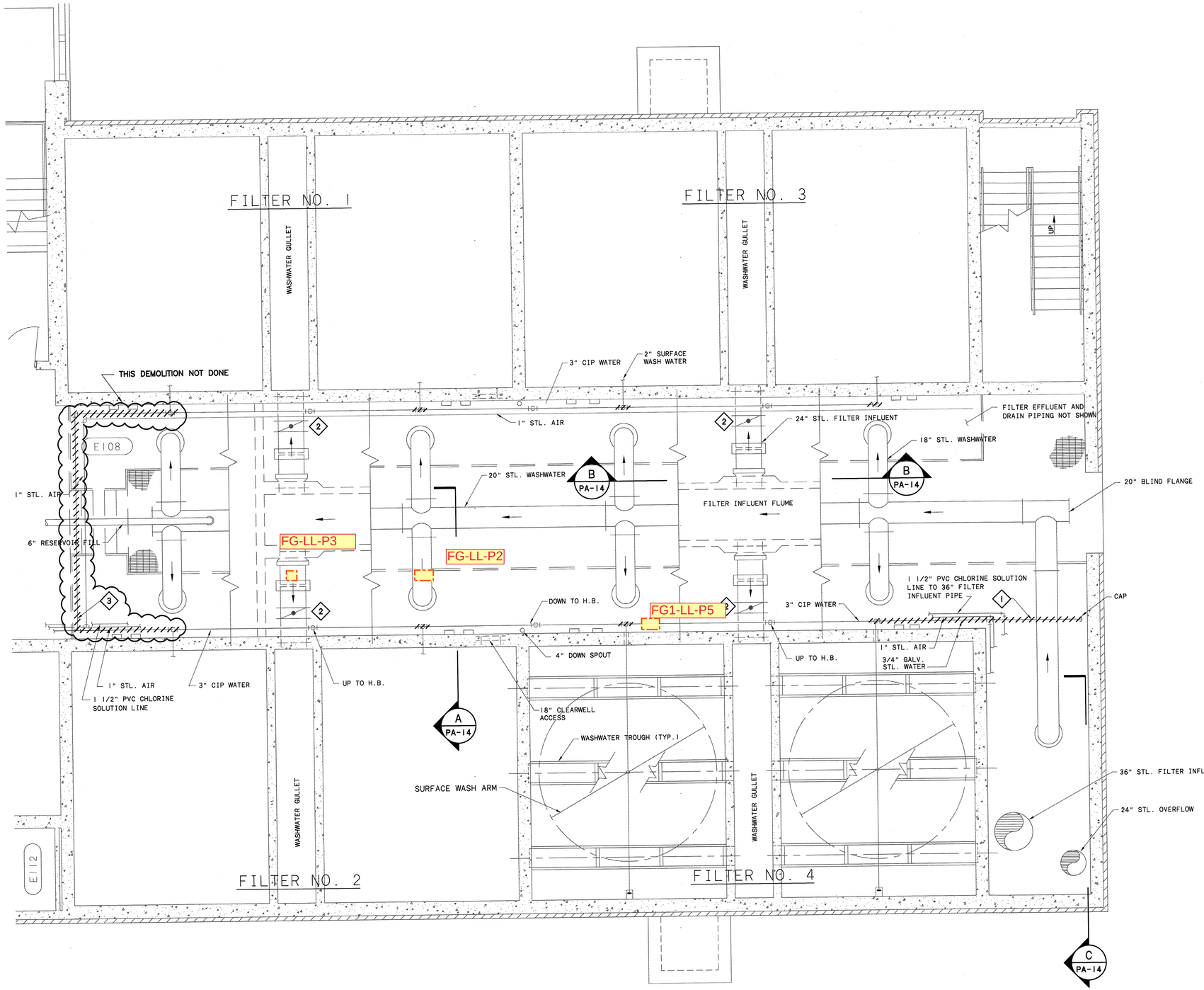
CITY OF CANTON

NO.	DESCRIPTION REVISIONS	DATE

JOB NO:	PR57484
DATE:	2019
DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
APPROVED BY:	XXX
SCALE:	NONE

PUMP ROOM FLOOR PLAN

SHEET OF



THIS DEMOLITION NOT DONE

3 REMOVE 3" C.I.P. WATER LINE FOR INSTALLATION OF REDUCED PRESSURE BACKFLOW PREVENTER SYSTEM.

2 ~~REPLACE VALVE ACTUATOR.~~ REPLACE VALVE AND VALVE ACTU

1 REMOVE 3/4" WATER LINE.

REVISED 8-98 AS CONSTRUCTED

THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE ENGINEERS ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	WEL
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

EXISTING FILTERS
PIPE GALLERY UPPER PLAN
DEMOLITION

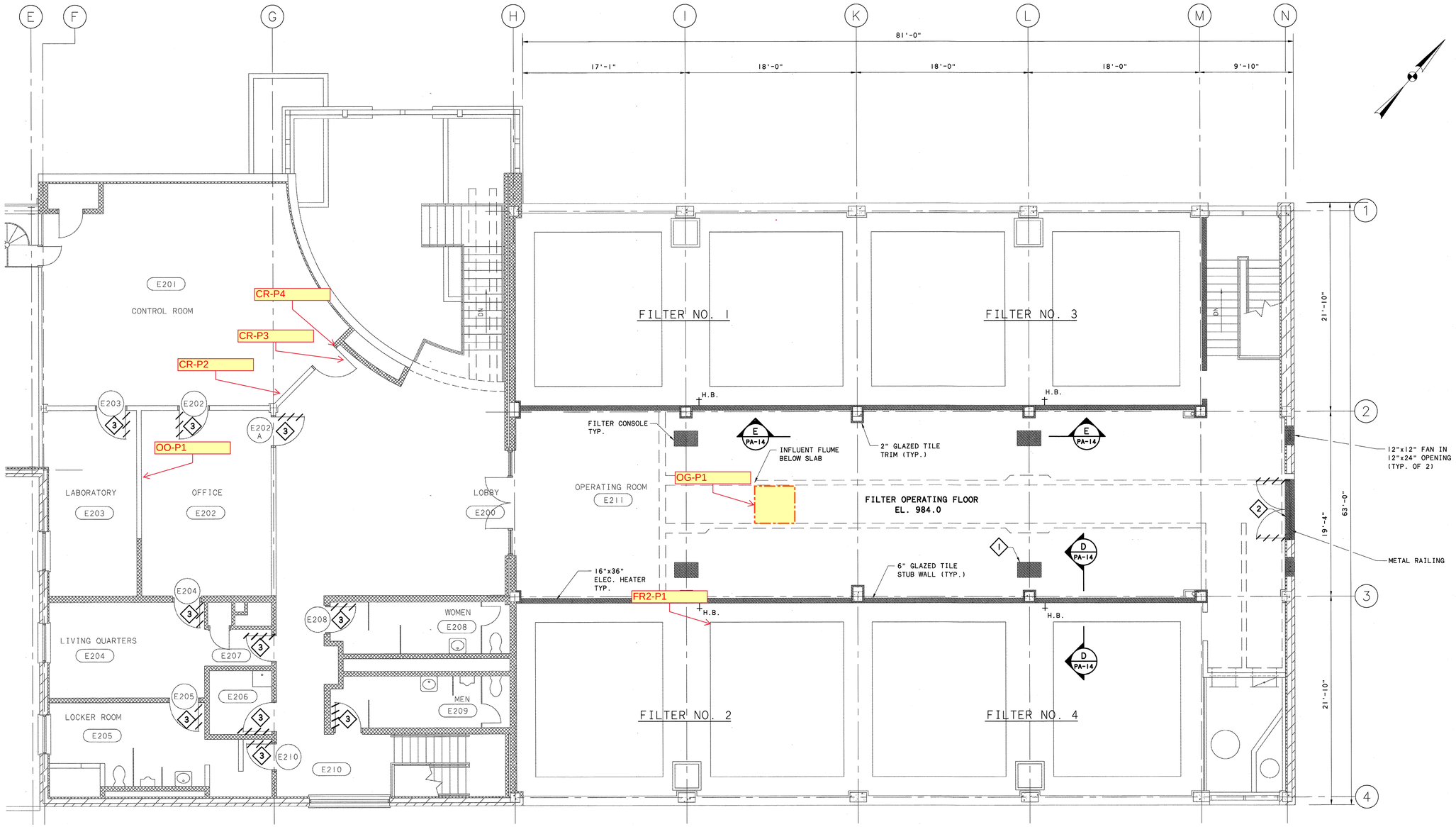
SCALE: 1/4" = 1'-0"

SHEET: PA-12

21 OF 104

Page 1868 of 1976

P:\PR16162\CADD\PA-12-SC.DWG 8-12-98 1:47:11 pm EST



PARTIAL PLAN

SCALE: 3/16" = 1'-0"

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

3 REMOVE DOOR AND MAINTAIN FRAME.

2 REMOVE EXISTING DOUBLE DOORS AND RAILING.

1 ELECTRICAL CONTRACTOR SHALL REMOVE EXISTING FILTER CONSOLES.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE ENGINEERS ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	WEL
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

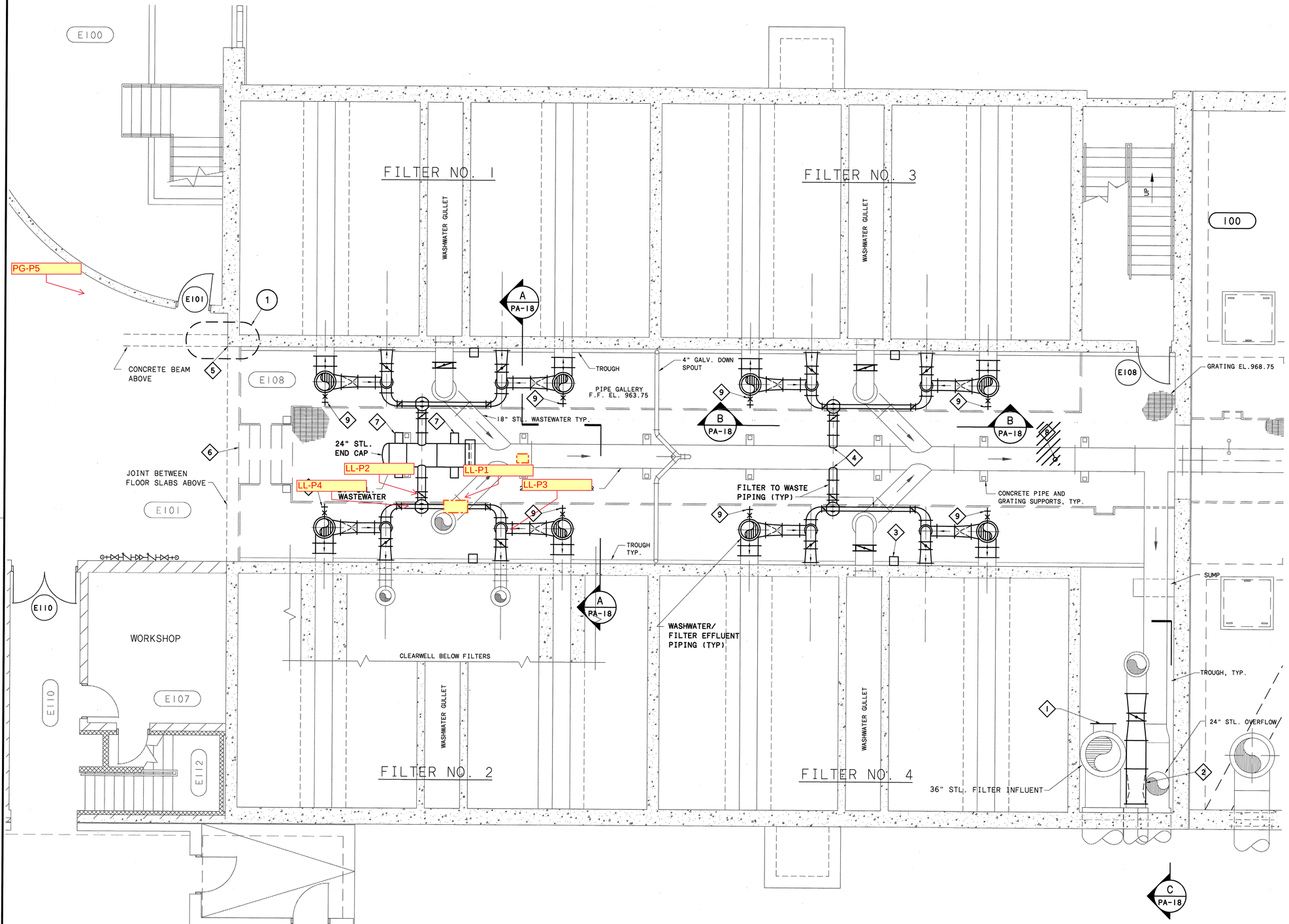
EXISTING FILTERS
OPERATING FLOOR PLAN
DEMOLITION

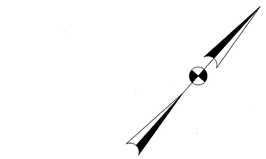
SCALE: AS NOTED

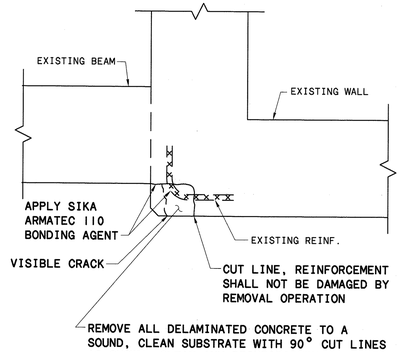
SHEET: PA-13

22 OF 104

P:\PR16162\CADD\PA-13-SC.DWG 8-12-98 2:02:17 pm EST







REMOVE ALL DELAMINATED CONCRETE TO A SOUND, CLEAN SUBSTRATE WITH 90° CUT LINES AS SHOWN, CLEAN ANY REINFORCEMENT BY WIRE BRUSH, APPLY BONDING AGENT, REPAIR AREA WITH SIKATOP 123 PLUS POLYMER MODIFIED, PORTLAND CEMENT PATCHING MORTAR PER MANUFACTURER'S INSTRUCTIONS.

REPAIR DETAIL (1)
NOT TO SCALE

9 1/2" TAP, CORP. STOP AND 1/2" BRONZE SAMPLE SPIGOT WITH SMOOTH NOSE.

~~8 CONNECTION TO ROOF DRAIN PIPING BY PLUMBING CONTRACTOR.~~

7 CONCRETE PIPE SUPPORT. SEE DETAIL 3 ON SHEET S-11.

6 CLEAN JOINT BETWEEN UNDERSIDE OF SLABS ABOVE AND CAULK JOINT. APPROXIMATELY 20 LINEAR FEET OF JOINT.

5 REMOVE DELAMINATED CONCRETE TO SOUND CONCRETE ALONG CRACK AT JUNCTION OF WALL, BEAM, AND SLAB ABOVE. APPLY BONDING AGENT AND PATCH WITH CEMENTITIOUS REPAIR MATERIAL. APPROXIMATELY 5 LINEAR FEET OF CRACK REPAIR. SEE DETAIL 1 ON THIS SHEET.

4 CUT OPENING IN 24" STL. PIPE TO ACCEPT 8" STL. DRAIN PIPE. REINFORCE OPENING BY WELDING A STEEL COLLAR ONTO THE 24" PIPE.

3 FILTER EFFLUENT TURBIDIMETER. TURBIDIMETER SHALL HAVE SAMPLE CONNECTIONS TO EACH FILTER HALF EFFLUENT PIPE. TYP. 4 METERS. SEE SCHEMATIC SHEET PA-25.

2 WASHWATER RATE OF FLOW METER SUPPLIED BY ELECTRICAL CONTRACTOR, INSTALLED BY GENERAL.

1 20" STL. BLIND FLANGE

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	JLT
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

EXISTING FILTERS
PIPE GALLERY
REVISED LOWER PLAN

SCALE: 1/4" = 1'-0"
SHEET: PA-15
24 of 104

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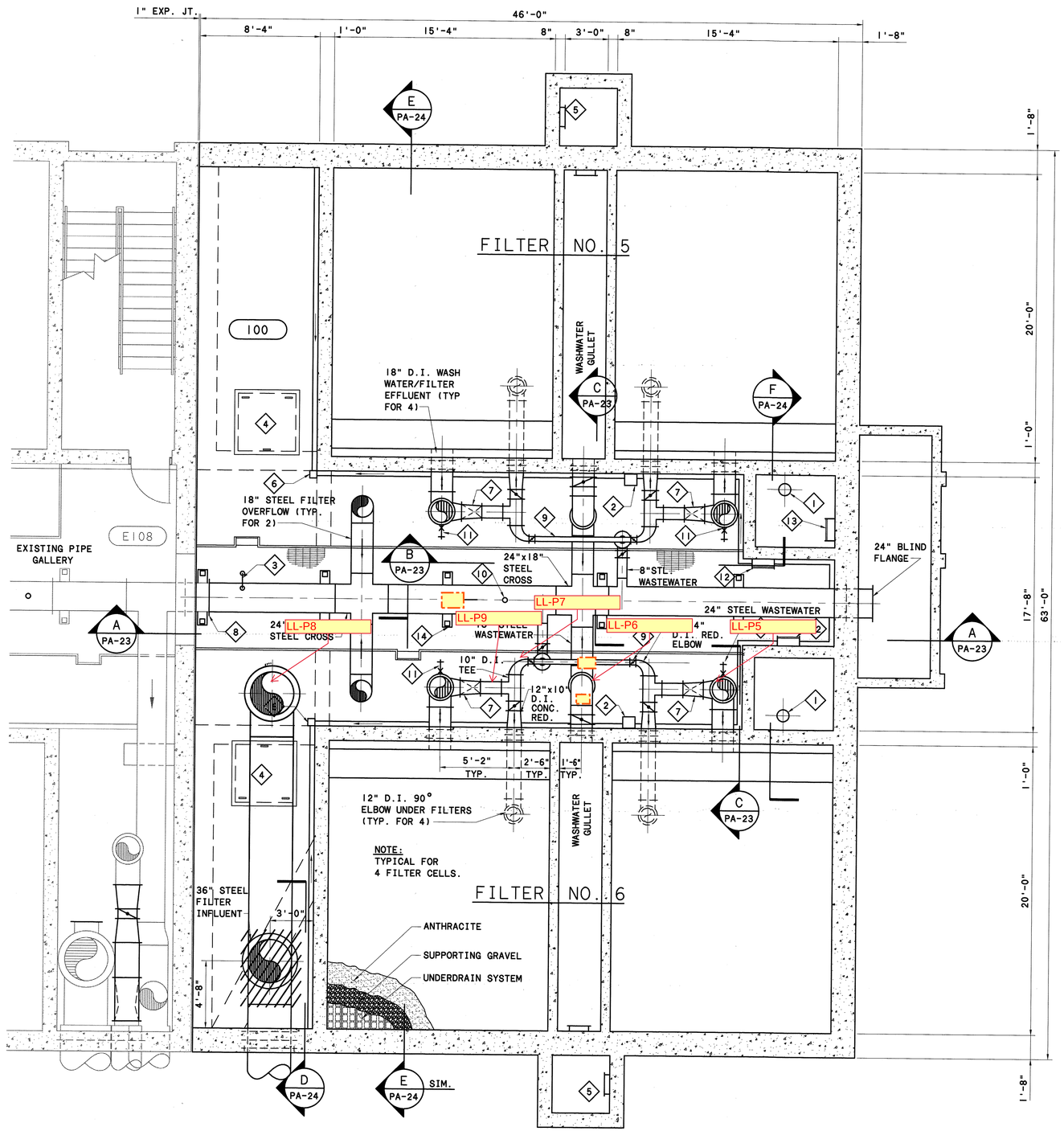

FILTER PIPE GALLERY LOWER PLAN

SCALE: 1/4" = 1'-0"

14 CONCRETE PIPE SUPPORT (TYP.)

13 FIXED FIBERGLASS ACCESS LADDER.

12 FIXED ALUMINUM LADDER.

11 1/2" TAP, CORP. STOP AND 1/2" BRONZE SAMPLE SPIGOT WITH SMOOTH NOSE.

10 CONNECTION FOR ROOF DRAIN PIPING BY PLUMBING CONTRACTOR.

9 4" DIP FILTER TO WASTE PIPING. TYP. 4.

8 REMOVE BLIND FLANGE AND CONNECT 24" STEEL WASTEWATER TO EXISTING 24" STEEL LINE. FIELD VERIFY EXACT LOCATION.

7 12"x10" FLOW TUBE, SUPPLIED BY ELECTRICAL CONTRACTOR, INSTALLED BY GENERAL.

6 FLOOR DRAIN BY PLUMBING CONTRACTOR.

5 CLEARWELL ACCESS MANHOLE TYPICAL FOR 2.

4 4'-0"x4'-0" ALUMINUM ACCESS DOOR, ~~WITH "LADDER UP" SAFETY POST BILCO TYPE "J" OR EQUAL WITH ALUMINUM FIXED LADDER ACCESS. (TYP.FOR 2)~~

3 SUMP PUMP DISCHARGE PIPING BY PLUMBING CONTRACTOR.

2 TURBIDIMETER TO FILTER EFFLUENT. TURBIDIMETER SHALL HAVE SAMPLE CONNECTIONS TO EACH FILTER CELL EFFLUENT PIPE. SEE SCHEMATIC SHEET PA-25.

1 EXTENSION BONNET FOR 42" DIA. BUTTERFLY VALVE. TYP. 2.

REVISED 8-98 AS CONSTRUCTED
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NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE ENGINEERS ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	JNV
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

FILTER PIPE GALLERY LOWER PLAN

SCALE: AS NOTED
SHEET: PA-20
29 Page 1863 of 1870 GP 104

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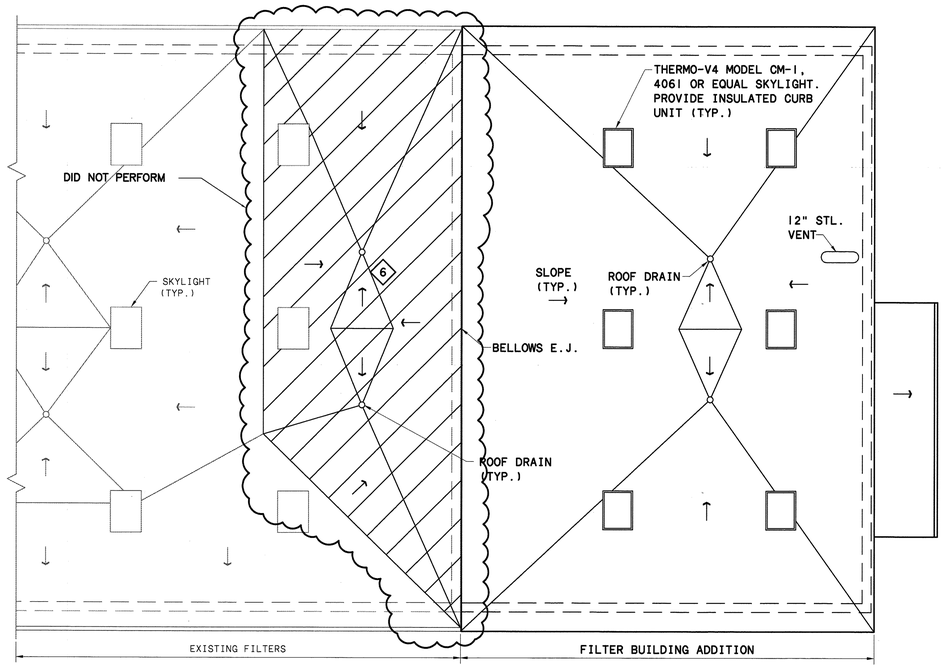
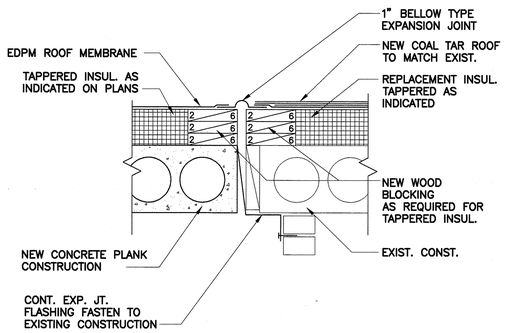


ROOF PLAN

SCALE: 1/8" = 1'-0"

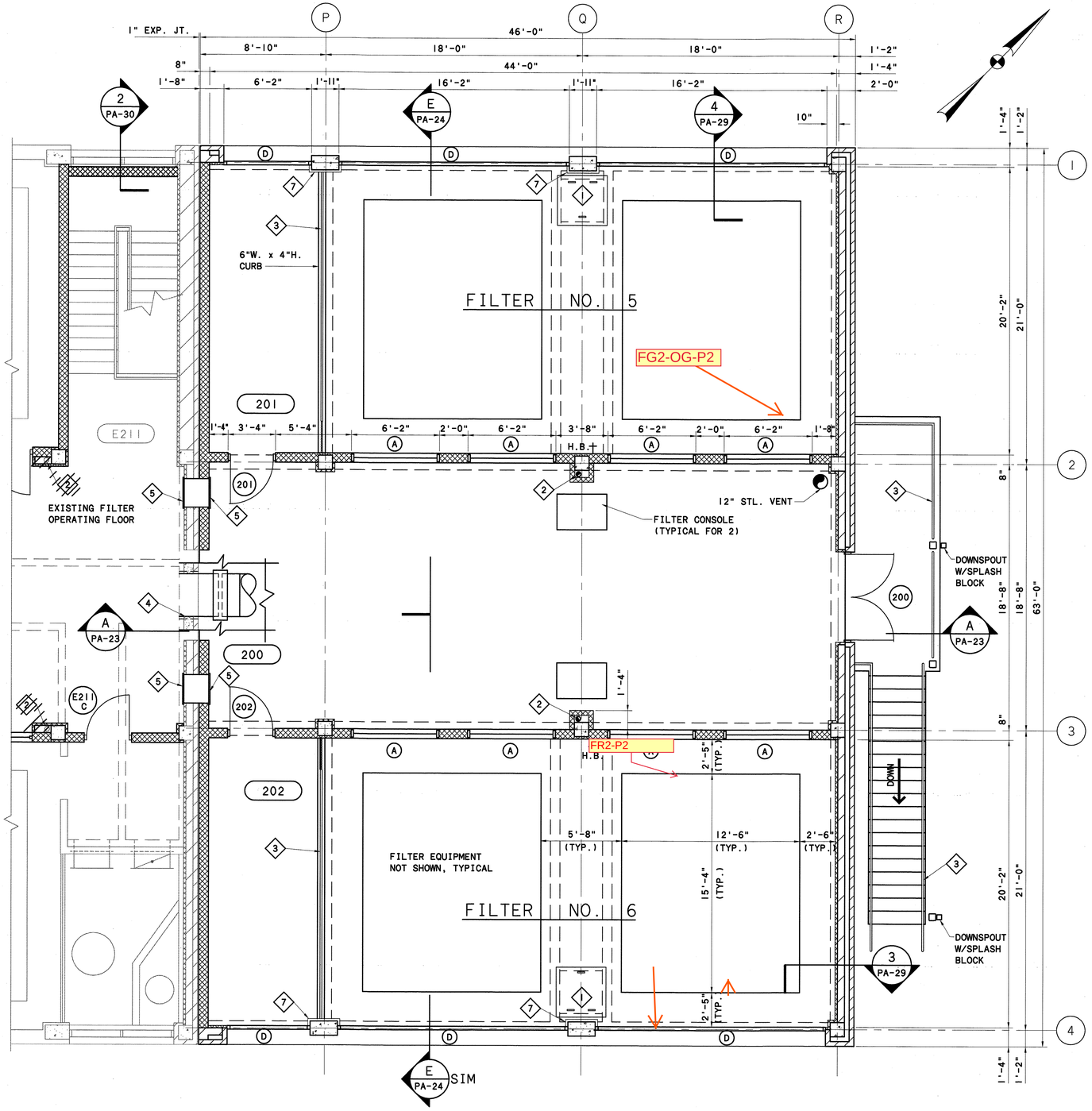
NOTE
ROOF PLAN DOES NOT SHOW ALL ROOF PENETRATIONS, PIPING AND EQUIPMENT. GENERAL CONTRACTOR SHALL LOCATE AND COORDINATE ALL ROOF RELATED ITEMS WITH THE PLUMBING, HVAC, AND ELECTRICAL CONTRACTORS.

7. GLAZED TILE TO UNDERSIDE OF WINDOW. PROVIDE COPING AT COLUMNS.
6. ~~REMOVE EXISTING ROOFING MATERIAL TO METAL DECK WITHIN CROSS HATCHED AREA. INSTALL NEW SINGLE PLY ROOFING SYSTEM AS SPECIFIED.~~
5. GRILLE. SEE HVAC DRAWINGS FOR DETAILS
4. CORE DRILL EXISTING 1'-4"± CONCRETE & BRICK WALL FOR 36" STEEL FILTER INFLUENT PIPE. SEAL WITH LINK SEAL OR EQUAL.
3. ALUMINUM RAILING (TYPICAL)
2. 4" ROOF DRAIN PIPING ENCLOSED IN 4" GLAZED TILE BLOCK
1. 3'-0"x3'-0" ALUMINUM ACCESS DOOR, BILCO TYPE J OR EQUAL WITH ALUMINUM FIXED LADDER ACCESS. TYP. 2.



TYPICAL EXP. JOINT DETAIL

SCALE: 1 1/2"=1'-0"



FILTER OPERATING FLOOR PLAN

SCALE: 1/4"=1'-0"

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	JMM
DRAWN BY:	JNV
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

FILTER OPERATING FLOOR AND ROOF PLANS

SCALE: AS NOTED
SHEET: PA-22
31 104

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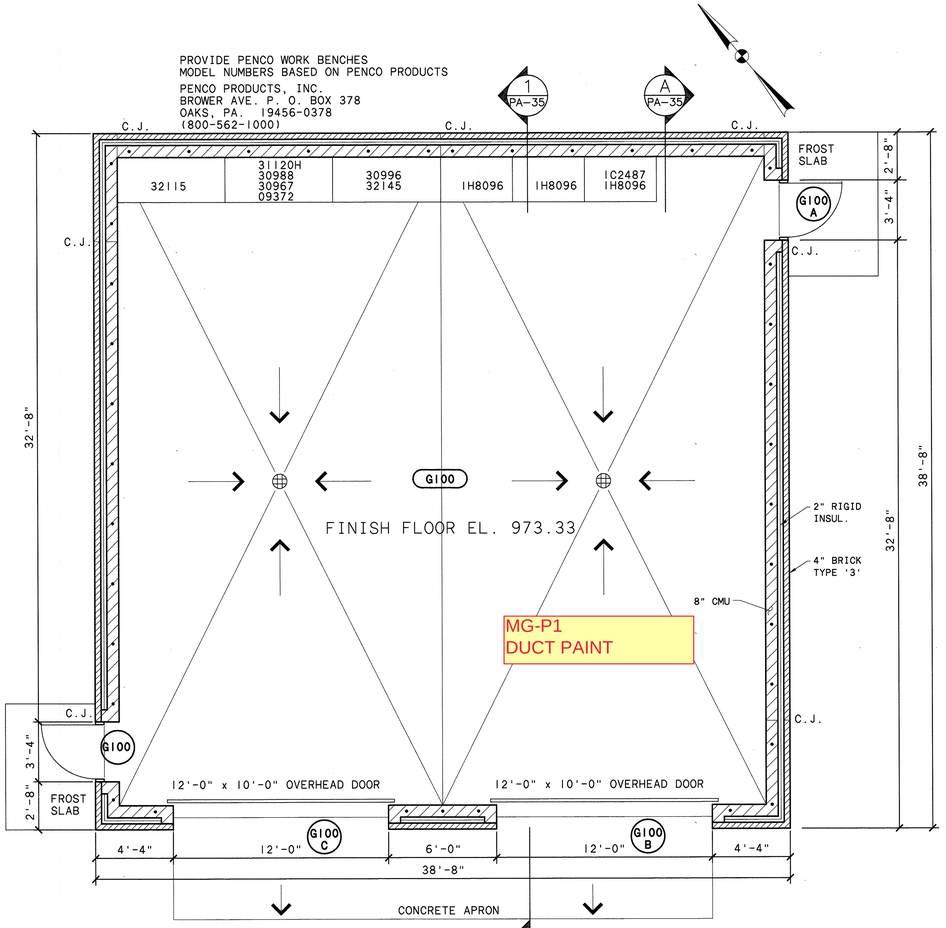
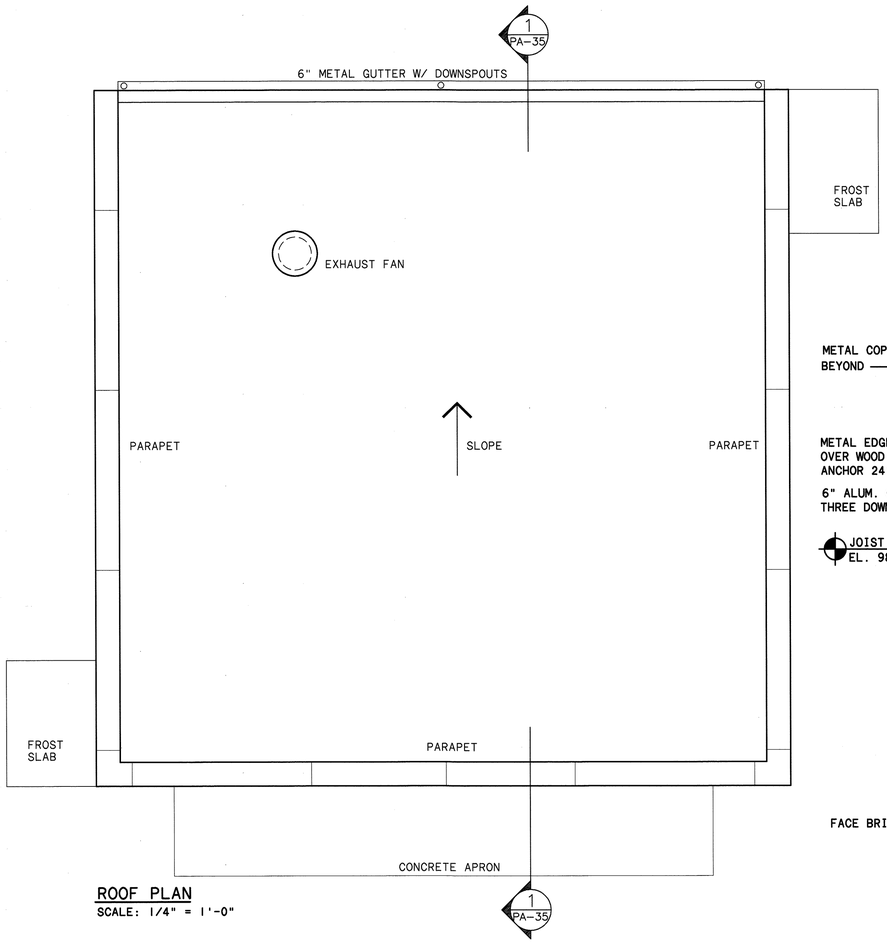
PROVIDE PENCO WORK BENCHES
MODEL NUMBERS BASED ON PENCO PRODUCTS

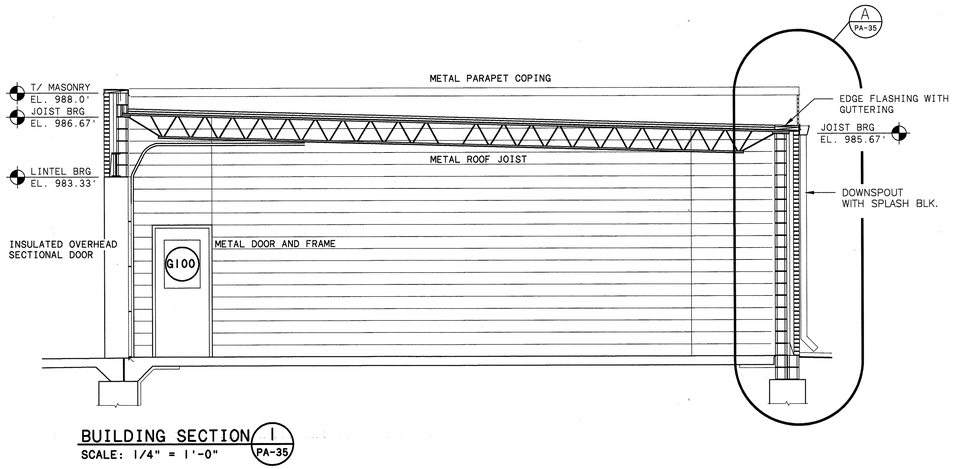
PENCO PRODUCTS, INC.
BROWER AVE. P. O. BOX 378
OAKS, PA. 19456-0378
(800-562-1000)



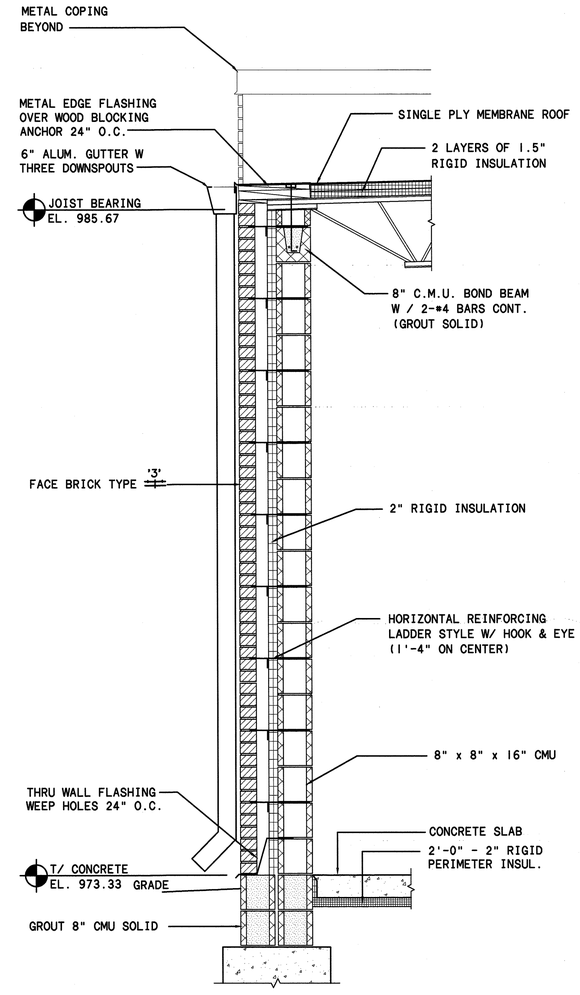
FLOOR PLAN
SCALE: 1/4" = 1'-0"



ROOF PLAN
SCALE: 1/4" = 1'-0"



BUILDING SECTION 1 PA-35
SCALE: 1/4" = 1'-0"



A PA-35 WALL SECTION
SCALE: 3/4" = 1'-0"

REVISED 8-98 AS CONSTRUCTED
THE INFORMATION SHOWN HEREON IS INTENDED TO BE COMPLETE AND CORRECT, HOWEVER, ALL PERSONS SHALL VERIFY INFORMATION TAKEN FROM THIS DRAWING.

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Limited PAINESVILLE, OH

BURGESS & NIPLE
ENGINEERS
ARCHITECTS

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
SUGAR CREEK PLANT
CONTRACT 95-4

JOB NO.	16162
DESIGNED BY:	ASW
DRAWN BY:	JNV
CHECKED BY:	DJK
APPROVED BY:	DJK
DATE:	OCTOBER 1995

GARAGE FLOOR AND ROOF PLANS
BUILDING SECTION

SCALE: AS NOTED
SHEET: PA-35
44 OF 104
Page 1865 of 1978

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BOILER EQUIPMENT ROOM

E106 + FF EL. 972.00

E110

E107

E112

FILTER NO. 2

OBSERVATION ROOM

+ FF EL. 972.00

CHLORINATION ROOM

+ FF EL. 972.00

SEE DETAIL 1/129

ALL WIRING IN CHEMICAL FEED ROOM SHALL BE WITHIN PVC SCH. 80 CONDUITS. ALL ELECTRICAL JUNCTION BOXES, PULL BOXES, PANELS, ETC. SHALL BE MENA 4X NON METALLIC CONSTRUCTION.

CL-P1

CL-P2

CHLORINE STORAGE ROOM

+ FF EL. 972.00

EXISTING CHLORINE GAS ALARM PANEL. (ACTUAL LOCATION NOT SHOWN.)

EXISTING CHLORINE GAS VACUUM SWITCH. (ACTUAL LOCATION NOT SHOWN.)

VAS R1309

LT R1301

NEW ULTRASONIC LEVEL TRANSMITTER, TYP OF 2

EXISTING CHEMICAL BULK TANKS

EXISTING RTU-13 WITH NEW PLC. SEE WIRING DIAGRAMS AND DETAILS, SHEET 84.

TO RTU-13 AI-R1301

LSL

EXISTING LEVEL SWITCHES TO REMAIN

LSH R1306 LSH R1307

EXISTING CHEMICAL DAY TANK

FLUORIDE BUILDING

+ FF EL. 969.67

NEW WEIGHT INDICATOR/ TRANSMITTER,

WIT R1303

LT R1302

TO RTU-13 AI-R1303

TO RTU-13 AI-R1302

EXISTING CHEMICAL FEED PUMPS STARTERS

1 3/4" C. WITH 2 #14 TO RTU-13 (DI-R1308)

2 3/4" C. WITH 2 #14 TO RTU-13 (DI-1309)

3 3/4" C. WITH 4 #14 TO RTU-13 (DO-R1311, R1312)

smr Engineering, PC
Electrical, Instrumentation & Control Systems Design
1595 E. Georgetown Rd.
Hudson, Ohio 44236
Phone 330/342-0597 *Fax* 330/342-0852

NO.	REVISIONS	DATE	BY	CHK.

Burgess & Niple, Inc. PAINESVILLE, OHIO

BURGESS & NIPLE

CITY OF CANTON WATER SYSTEM IMPROVEMENTS
WATER TREATMENT PLANT UPGRADES
CONTRACT 2006-33

JOB NO.	PR42826
DESIGNED BY:	SMR
DRAWN BY:	XXX
CHECKED BY:	SMR
APPROVED BY:	SMR
DATE:	MARCH 2007

SUGARCREEK WTP
CHLORINE ROOM AND FLUORIDE BUILDING
FIRST FLOOR PLAN

SCALE: 1/4"=1'-0"

SHEET NO. 54 OF 132

EA GROUP
Environmental Analysis and Management

APPENDIX D

Laboratory Analytical Report(s)

EA GROUP
Environmental Analysis and Management

Burgess & Niple
100 W. Erie St.
Painesville, OH 44077
Carl Seifried

Client Project: Canton Sugar Creek WTP
EA Group Workorder Number: 200900288
Received on September 29, 2020

The following analytical report contains results as requested for samples submitted to EA Group. The results included in this report have been reviewed for compliance with the analytical methods indicated in this report. All data has been found to be compliant with accepted laboratory protocol, except as noted in the QC narrative. Industrial hygiene reports, air and/or surface concentrations results are based upon sampling information provided by the client. Industrial hygiene results will not be blank corrected. Analyst initials of REF indicate analysis performed at a subcontract facility.

If you have questions, comments or require further assistance regarding this report, please contact your client services representative or one of the individuals listed below.

Data or reporting:
Debbie Lauer - Lab Manager
dlauer@eagroupohio.com

Mike Herbert - General Manager
mherbert@eagroupohio.com

Sample tracking, supplies:
Haley Imler - Sample Control
sreceiving@eagroupohio.com

Invoice Related:
Bonnie Renbarger - Office Manager
brenbarger@eagroupohio.com

EA GROUP
Environmental Analysis and Management

Laboratory Analytical Report

Burgess & Niple
100 W. Erie St.
Painesville, OH 44077

Attention:
Carl Seifried

Project Identification
Canton Sugar Creek WTP

OH43702
Purchase Order:

EA Group
Order Number
2009-00288

Carl R. Eggebraaten
Microscopist

Deborah L. Lauer
Laboratory Manager

October 5, 2020

7118 Industrial Park Blvd., Mentor, Ohio 44060-5314
(440) 951-3514 (800) 875-3514 FAX (440) 951-3774 www.eagroupohio.com

EA GROUP
Environmental Analysis and Management

Project Summary

The following analytical report contains the results as requested for samples submitted to EA Group. The results included in this report have been reviewed for compliance with the analytical methods indicated in this report. All data have been found to be compliant with accepted laboratory protocol. Exceptions, if any, are noted below.

Sample Summary

Sample Receive Date: 9/29/2020

EAG Sample Identification	Client Sample Identification	EAG Sample Identification	Client Sample Identification
200900288-01A	OH43702-RS-WS1	200900288-02A	OH43702-RS-WS2
200900288-03A	OH43702-ML-CL1	200900288-04A	OH43702-OO-CL2
200900288-05A	OH43702-CR-CL3	200900288-06A	OH43702-ML-CL5
200900288-07A	OH43702-MT-CL6	200900288-08A	OH43702-MT-CL7
200900288-09A	OH43702-MR-PL1	200900288-10A	OH43702-MR-PL2
200900288-11A	OH43702-MR-PL3	200900288-12A	OH43702-SR-WS1
200900288-13A	OH43702-SR-WS2	200900288-14A	OH43702-MR-WS1
200900288-15A	OH43702-MR-WS2	200900288-16A	OH43702-MR-DS1
200900288-17A	OH43702-MR-DS2	200900288-18A	OH43702-EL-DS1
200900288-19A	OH43702-EL-DS2	200900288-20A	OH43702-EL-WS1
200900288-21A	OH43702-EL-WS2	200900288-22A	OH43702-LL-DS1
200900288-23A	OH43702-LL-DS2	200900288-24A	OH43702-MG-DS1
200900288-25A	OH43702-MG-DS2	200900288-26A	OH43702-CL-WS1
200900288-27A	OH43702-CL-WS2	200900288-28A	OH43702-CL-DS1
200900288-29A	OH43702-CL-DS4	200900288-30A	OH43702-CL-DS2
200900288-31A	OH43702-CL-DS3	200900288-32A	OH43702-FL-DS1
200900288-33A	OH43702-FL-DS2	200900288-34A	OH43702-OG-DS1
200900288-35A	OH43702-OG-DS2	200900288-36A	OH43702-OG-DS3
200900288-37A	OH43702-OG-DS4	200900288-38A	OH43702-OG-WS1
200900288-39A	OH43702-OG-WS2	200900288-40A	OH43702-FR2-WS1
200900288-41A	OH43702-FR2-WS2	200900288-42A	OH43702-FR2-WS3
200900288-43A	OH43702-FR2-WS4	200900288-44A	OH43702-GB-A1
200900288-45A	OH43702-GB-A2	200900288-46A	OH43702-GB-A3
200900288-47A	OH43702-GB-A4	200900288-48A	OH43702-GN-LS1
200900288-49A	OH43702-GN-LS2	200900288-50A	OH43702-GN-DS1
200900288-51A	OH43702-GN-DS2	200900288-52A	OH43702-AW-R1
200900288-53A	OH43702-AW-R4	200900288-54A	OH43702-AW-R2
200900288-55A	OH43702-AW-R3	200900288-56A	OH43702-AW-B1
200900288-57A	OH43702-AW-B2	200900288-58A	OH43702-AW-DS1
200900288-59A	OH43702-AW-DS2	200900288-60A	OH43702-AE-B1
200900288-61A	OH43702-AE-B2	200900288-62A	OH43702-AE-DS1
200900288-63A	OH43702-AE-DS2		

Quality Control Narrative

EA GROUP
Environmental Analysis and Management

Project Summary

The following analytical report contains the results as requested for samples submitted to EA Group. The results included in this report have been reviewed for compliance with the analytical methods indicated in this report. All data have been found to be compliant with accepted laboratory protocol. Exceptions, if any, are noted below.

Sample Summary

Sample Receive Date: 9/29/2020

EAG Sample Identification	Client Sample Identification	EAG Sample Identification	Client Sample Identification

This report contains data which was produced by a subcontracted laboratory

NVLAP Lab Code 101165-0 for Asbestos Analysis.

IATL, Inc.

9000 Commerce Parkway, Suite B

Mt. Laurel, NJ 08054

 Unless noted, soil, sludge, and sediment results are reported on dry weight basis. The "Sample Reporting Limit" is based on the method used for analysis and does not refer to any regulatory limit.

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

9000 Commerce Parkway Suite B
Mt. Laurel, New Jersey 08054
Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069792
Client No.: OH43702-RS-WS1
Analyst Observation: Grey Caulk
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069793
Client No.: OH43702-RS-WS2
Analyst Observation: Grey Caulk
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069794
Client No.: OH43702-ML-CL1
Analyst Observation: White/Brown Drywall
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: 20 Cellulose
Percent Non-Fibrous Material: 80

Lab No.: 7069794(L2)
Client No.: OH43702-ML-CL1
Analyst Observation: White Joint Compound
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069795
Client No.: OH43702-00-CL2
Analyst Observation: White/Brown Drywall
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: 20 Cellulose
Percent Non-Fibrous Material: 80

Lab No.: 7069795(L2)
Client No.: OH43702-00-CL2
Analyst Observation: White Joint Compound
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/1/2020
Date Analyzed: 10/02/2020
Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069796
Client No.: OH43702-CR-CL3

Analyst Observation: White/Brown Drywall
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
20 Cellulose

Percent Non-Fibrous Material:
80

Lab No.: 7069796(L2)
Client No.: OH43702-CR-CL3

Analyst Observation: White Joint Compound
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069797
Client No.: OH43702-ML-CL5

Analyst Observation: White/Brown Drywall
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
18 Cellulose
8 Fibrous Glass

Percent Non-Fibrous Material:
74

Lab No.: 7069797(L2)
Client No.: OH43702-ML-CL5

Analyst Observation: White Joint Compound
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069798
Client No.: OH43702-MT-CL6

Analyst Observation: White/Brown Drywall
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
18 Cellulose
8 Fibrous Glass

Percent Non-Fibrous Material:
74

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Date Received: 10/1/2020
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Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
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Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069798(L2)
Client No.: OH43702-MT-CL6

Analyst Observation: White Joint Compound
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069799
Client No.: OH43702-MT-CL7

Analyst Observation: White/Brown Drywall
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
18 Cellulose
8 Fibrous Glass

Percent Non-Fibrous Material:
74

Lab No.: 7069799(L2)
Client No.: OH43702-MT-CL7

Analyst Observation: White Joint Compound
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069800
Client No.: OH43702-MR-PL1

Analyst Observation: Grey/White Insulation
Client Description:

Location:
Facility:

Percent Asbestos:
12 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
80 Mineral Wool

Percent Non-Fibrous Material:
8

Lab No.: 7069801
Client No.: OH43702-MR-PL2

Analyst Observation: Grey/White Insulation
Client Description:

Location:
Facility:

Percent Asbestos:
15 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
80 Mineral Wool

Percent Non-Fibrous Material:
5

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/1/2020
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Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069802
Client No.: OH43702-MR-PL3

Analyst Observation: Grey/White Insulation
Client Description:

Location:
Facility:

Percent Asbestos:
15 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
70 Mineral Wool

Percent Non-Fibrous Material:
15

Lab No.: 7069803
Client No.: OH43702-SR-WS1

Analyst Observation: Grey Glazing
Client Description:

Location:
Facility:

Percent Asbestos:
PC 5.4 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
94.6

Lab No.: 7069804
Client No.: OH43702-SR-WS2

Analyst Observation: Grey Glazing
Client Description:

Location:
Facility:

Percent Asbestos:
PC 6.1 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
93.9

Lab No.: 7069805
Client No.: OH43702-MR-WS1

Analyst Observation: Grey Glazing
Client Description:

Location:
Facility:

Percent Asbestos:
PC 5.7 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
94.3

Lab No.: 7069806
Client No.: OH43702-MR-WS2

Analyst Observation: Grey Glazing
Client Description:

Location:
Facility:

Percent Asbestos:
PC 5.9 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
94.1

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Date Received: 10/1/2020
Date Analyzed: 10/02/2020
Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069807
Client No.: OH43702-MR-DS1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069808
Client No.: OH43702-MR-DS2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069809
Client No.: OH43702-EL-DS1

Analyst Observation: Silver Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
PC 4.3 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95.7

Lab No.: 7069810
Client No.: OH43702-EL-DS2

Analyst Observation: Silver Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
PC 4.6 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95.4

Lab No.: 7069811
Client No.: OH43702-EL-WS1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

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Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069812
Client No.: OH43702-EL-WS2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069812(L2)
Client No.: OH43702-EL-WS2

Analyst Observation: Grey Concrete
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069813
Client No.: OH43702-LL-DS1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069814
Client No.: OH43702-LL-DS2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069815
Client No.: OH43702-MG-DS1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

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Analyst: Natalia Morais Soares

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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
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Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069816 **Client No.:** OH43702-MG-DS2	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069817 **Client No.:** OH43702-CL-WS1	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069818 **Client No.:** OH43702-CL-WS2	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069819 **Client No.:** OH43702-CL-DS1	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069820 **Client No.:** OH43702-CL-DS4	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100

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Date Received: 10/1/2020
Date Analyzed: 10/02/2020
Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069821 **Client No.:** OH43702-CL-DS2	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069822 **Client No.:** OH43702-CL-DS3	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069823 **Client No.:** OH43702-FL-DS1	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069824 **Client No.:** OH43702-FL-DS2	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069825 **Client No.:** OH43702-OG-DS1	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069826 **Client No.:** OH43702-OG-DS2	**Analyst Observation:** Grey Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100

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Date Received: 10/1/2020
Date Analyzed: 10/02/2020
Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069827
Client No.: OH43702-OG-DS3

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069828
Client No.: OH43702-OG-DS4

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069829
Client No.: OH43702-OG-WS1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069830
Client No.: OH43702-OG-WS2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069831
Client No.: OH43702-FR2-WS1

Analyst Observation: Black Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

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Date Received: 10/1/2020
Date Analyzed: 10/02/2020
Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
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Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069832 **Client No.:** OH43702-FR2-WS2	**Analyst Observation:** Black Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069833 **Client No.:** OH43702-FR2-WS3	**Analyst Observation:** Black Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069834 **Client No.:** OH43702-FR2-WS4	**Analyst Observation:** Black Caulk **Client Description:**	**Location:** **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 7069835 **Client No.:** OH43702-GB-A1	**Analyst Observation:** Tan Glazing **Client Description:**	**Location:** **Facility:**
Percent Asbestos: ***PC 3.6*** *Chrysotile*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 96.4
Lab No.: 7069836 **Client No.:** OH43702-GB-A2	**Analyst Observation:** Tan Glazing **Client Description:**	**Location:** **Facility:**
Percent Asbestos: ***PC 3.4*** *Chrysotile*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 96.6
Lab No.: 7069837 **Client No.:** OH43702-GB-A3	**Analyst Observation:** Tan Glazing **Client Description:**	**Location:** **Facility:**
Percent Asbestos: ***PC 4.2*** *Chrysotile*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 95.8

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/1/2020
Date Analyzed: 10/02/2020
Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069838
Client No.: OH43702-GB-A4

Analyst Observation: Tan Glazing
Client Description:

Location:
Facility:

Percent Asbestos:
PC 3.8 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
96.2

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/1/2020
Date Analyzed: 10/02/2020
Signature: Natalia Morais Soares
Analyst: Natalia Morais Soares

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069839
Client No.: OH43702-GN-LS1
Analyst Observation: Grey/Silver Caulk
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069840
Client No.: OH43702-GN-LS2
Analyst Observation: Tan Caulk
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069841
Client No.: OH43702-GN-DS1
Analyst Observation: Grey Caulk
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069842
Client No.: OH43702-GN-DS2
Analyst Observation: Grey Caulk
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069843
Client No.: OH43702-AW-R1
Analyst Observation: Tan Foam
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069843(L2)
Client No.: OH43702-AW-R1
Analyst Observation: Black Tar
Client Description:
Location:
Facility:

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/1/2020
Date Analyzed: 10/03/2020
Signature:
Analyst: Christopher Riffe

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069843(L3) **Analyst Observation:** Grey Insulation **Location:**
Client No.: OH43702-AW-R1 **Client Description:** **Facility:**

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: 85 Cellulose, 15 Fibrous Glass
Percent Non-Fibrous Material: None Detected

Lab No.: 7069844 **Analyst Observation:** Tan/Yellow Foam **Location:**
Client No.: OH43702-AW-R4 **Client Description:** **Facility:**

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069844(L2) **Analyst Observation:** Black Tar **Location:**
Client No.: OH43702-AW-R4 **Client Description:** **Facility:**

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: None Detected
Percent Non-Fibrous Material: 100

Lab No.: 7069844(L3) **Analyst Observation:** Grey Insulation **Location:**
Client No.: OH43702-AW-R4 **Client Description:** **Facility:**

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: 85 Cellulose, 15 Fibrous Glass
Percent Non-Fibrous Material: None Detected

Lab No.: 7069845 **Analyst Observation:** Black Roof Material **Location:**
Client No.: OH43702-AW-R2 **Client Description:** **Facility:**

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: 25 Synthetic
Percent Non-Fibrous Material: 75

Lab No.: 7069846 **Analyst Observation:** Black Roof Material **Location:**
Client No.: OH43702-AW-R3 **Client Description:** **Facility:**

Percent Asbestos: *None Detected*
Percent Non-Asbestos Fibrous Material: 25 Synthetic
Percent Non-Fibrous Material: 75

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Date Received: 10/1/2020
Date Analyzed: 10/03/2020
Signature:
Analyst: Christopher Riffe

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

9000 Commerce Parkway Suite B
Mt. Laurel, New Jersey 08054
Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069847
Client No.: OH43702-AW-B1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069848
Client No.: OH43702-AW-B2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069849
Client No.: OH43702-AW-DS1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069850
Client No.: OH43702-AW-DS2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069851
Client No.: OH43702-AE-B1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069852
Client No.: OH43702-AE-B2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/1/2020
Date Analyzed: 10/03/2020
Signature:
Analyst: Christopher Riffe

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

iATL INTERNATIONAL
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CERTIFICATE OF ANALYSIS

Client: EA Group
7118 Industrial Park
Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 7069853
Client No.: OH43702-AE-DS1

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069853(L2)
Client No.: OH43702-AE-DS1

Analyst Observation: White Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 7069854
Client No.: OH43702-AE-DS2

Analyst Observation: Grey Caulk
Client Description:

Location:
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/1/2020
Date Analyzed: 10/03/2020
Signature:
Analyst: Christopher Riffe

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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CERTIFICATE OF ANALYSIS

Client:	EA Group	Report Date:	10/3/2020
	7118 Industrial Park	Report No.:	620349 - PLM
	Mentor OH 44060	Project:	OH43702
		Project No.:	2009-00288
Client:	EAG482		

Appendix to Analytical Report

Customer Contact: Mike Herbert
Method:40 CFR Appendix E to Subpart E of Part 763, interim method for the Determination of Asbestos in Bulk Insulation Samples, and USEPA 600, R93-116 as needed.

This appendix seeks to promote greater understanding of any observations, exceptions, special instructions, or circumstances that the laboratory needs to communicate to the client concerning the above samples. The information below is used to help promote your ability to make the most informed decisions for you and your customers. Please note the following points of contact for any questions you may have.

iATL Customer Service: customerservice@iatl.com
iATL Office Manager:wchampion@iatl.com
iATL Account Representative: Semih Kocahasan
Sample Login Notes: See Batch Sheet Attached
Sample Matrix: Bulk Building Materials
Exceptions Noted: See Following Pages

General Terms, Warrants, Limits, Qualifiers:

General information about iATL capabilities and client/laboratory relationships and responsibilities are spelled out in iATL policies that are listed at www.iATL.com and ir our Quality Assurance Manual per ISO 17025 standard requirements. The information therein is a representation of iATL definitions and policies for turnaround times, sample submittal, collection media, blank definitions, quantification issues and limit of detection, analytical methods and procedures, sub-contracting policies, results reporting options, fees, terms, and discounts, confidentiality, sample archival and disposal, and data interpretation.

iATL warrants the test results to be of a precision normal for the type and methodology employed for each sample submitted. iATL disclaims any other warrants, expressed or implied, including warranty of fitness for a particular purpose and warranty of merchantability. iATL accepts no legal responsibility for the purpose for which the client uses test results. Any analytical work performed must be governed by our Standard Terms and Conditions. Prices, methods and detection limits may be changed without notification. Please contact your Customer Service Representative for the most current information.

This confidential report relates only to those item(s) tested and does not represent an endorsement by NIST-NVLAP, AIHA LAP LLC, or any agency of local, state or province governments nor of any agency of the U.S. government.

This report shall not be reproduced except in full, without written approval of the laboratory.

Information Pertinent to this Report:

Analysis by US EPA 600 93-116: Determination of Asbestos in Bulk Building Materials by Polarized Light Microscopy (PLM).

Certifications:

- NIST-NVLAP No. 101165-0
- NYSDOH-ELAP No. 11021
- AIHA-LAP, LLC No. 100188

Quantification at <0.25% by volume is possible with this method. (PC) Indicates Stratified Point Count Method performed. (PC-Trace) means that asbestos was detected but is not quantifiable under the Point Counting regimen. PC Trace represents a <0.25% amount. Analysis includes all distinct separable layers in accordance with EPA 600 Method. If not reported or otherwise noted, layer is either not present or the client has specifically requested that it not be analyzed (ex. analyze until positive instructions). Small asbestos fibers may be missed by PLM due to resolution limitations of the optical microscope. Therefore, PLM is not consistently reliable in detecting asbestos in non-friable organically bound (NOB) materials. Quantitative transmission electron microscopy (TEM) is currently the only method that can pronounce materials as non-asbestos containing.

Analytical Methodology Alternatives: Your initial request for analysis may not have accounted for recent advances in regulatory requirements or advances in technology that are routinely used in similar situations for other qualified projects. You may have the option to explore additional analysis for further information. Below are a few options, listed as the matrix followed by the appropriate methodology. Also included are links to more information on our website.

Bulk Building Materials that are Non-Friable Organically Bound (NOB) by Gravimetric Reduction techniques employing PLM and TEM: ELAP 198.6 (PLM-NOB), ELAP 198.4 (TEM-NOB)

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CERTIFICATE OF ANALYSIS

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Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

Loose Fill Vermiculite Insulation, Attic Insulation, Zonolite (copyright), etc.: US EPA 600 R-4/004 (multi-tiered analytical process)
Sprayed On Insulation/Fireproofing with Vermiculite (SOF-V): ELAP 198.8 (PLM-SOF-V)

Soil, sludge, sediment, aggregate, and like materials analyzed for asbestos or other elongated mineral particles (ex. erionite, etc.): ASTM D7521, CARB 435, and other options available

Asbestos in Surface Dust according to one of ASTM's Methods (very dependent on sampling collection technique – by TEM): ASTM D 5755, D5756, or D6480

Various other asbestos matrices (air, water, etc.) and analytical methods are available.

Disclaimers / Qualifiers:

There may be some samples in this project that have a "NOTE:" associated with a sample result. We use added disclaimers or qualifiers to inform the client about something that requires further explanation. Here is a list with highlighted disclaimers that may be pertinent to this project. For a full explanation of these and other disclaimers, please inquire at **customerservice@iatl.com**.

1) Note: No mastic provided for analysis.
2) Note: Insufficient mastic provided for analysis.
3) Note: Insufficient material provided for analysis.
4) Note: Insufficient sample provided for QC reanalysis.
5) Note: Different material than indicated on Sample Log / Description.
6) Note: Sample not submitted.
7) Note: Attached to asbestos containing material.
8) Note: Received wet.
9) Note: Possible surface contamination.
10) Note: Not building material. 1% threshold may not apply.
11) Note: Recommend TEM-NOB analysis as per EPA recommendations.
12) Note: Asbestos detected but not quantifiable.
13) Note: Multiple identical samples submitted, only one analyzed.
14) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.080%.
15) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.125%.
16) Note: This sample contains >10% vermiculite mineral. See Appendix for Recommendations for Vermiculite Analysis.

Recommendations for Vermiculite Analysis:

Several analytical protocols exist for the analysis of asbestos in vermiculite. These analytical approaches vary depending upon the nature of the vermiculite mineral being tested (e.g. un-processed gange, homogeneous exfoliated books of mica, or mixed mineral composites).Please contact your client representative for pricing and turnaround time options available.

iATL recommends initial testing using the EPA 600/R-93/116 method. This method is specifically designed for the analysis of asbestos in bulk building materials. It provides an acceptable starting point for primary screening of vermiculite for possible asbestos.

Results from this testing may be inconclusive. EPA suggests proceeding to a multi-tiered analysis involving wet separation techniques in conjunction with PLM and TEM gravimetric analysis (EPA 600/R-04/004).

For New York State customers, NYSDOH requires disclaimers and qualifiers for various vermiculite containing samples that direct analysis via ELAP198.6 and ELAP198.8 for samples that contain >10% vermiculite mineral where ELAP198.6 may be used to evaluate the asbestos content of the material. However, any test result using ELAP198.6 will be reported with the following disclaimer: “ELAP198.6 method does not remove vermiculite and may underestimate the level of asbestos present in a sample containing >10% vermiculite.”

Further information on this method and other vermiculite and asbestos issues can be found at the following: Agency for Toxic Substances and Disease Registry (ATSDR) www.atsdr.cdc.gov, United States Geological Survey (USGS) www.minerals.usgs.gov/minerals/, US EPA www.epa.gov/asbestos. The USEPA also has an informative brochure "Current Best Practices for Vermiculite Attic Insulation" EPA 747F03001 May 2003, that may assist the health and remediation professional. NYS customers please follow current NYSDOH ELAP requirements per policy on subject of surfacing and vermiculite, May 6, 2016, Testing Requirements for Surfacing Material Containing Vermiculite (https://www.wadsworth.org/sites/default/files/WebDoc/I198_8_02_2.pdf)

The following is a summary of the analytical process outlines in the EPA 600/R-04/004 Method:

1)**Analytical Step/Method:** Initial Screening by PLM, EPA 600R-93/116
Requirements/Comments: Minimum of 0.1 g of sample. ~0.25% for most samples.

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Mentor OH 44060

Client: EAG482

Report Date: 10/3/2020
Report No.: 620349 - PLM
Project: OH43702
Project No.: 2009-00288

2)**Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.

3)**Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Floats" only.

4)**Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.

5)**Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Suspension" only.
*With advance notice and confirmation by the laboratory.
**Approximately 1 Liter of sample in double-bagged container (~9x6 inch bag of sample).

288

FIELD REQUEST FOR LABORATORY ANALYSIS

Company Name: Burgess+Niple

Address:

Attention: Mr. Carl Seifried

Customer Number: U011236

Results Needed By:

Normal: X RUSH:

Priority: (confirm w/ lab)

Date: 10/5 Time:

Telephone: Fax No:

e-mail:

Sampled by: CiFalatic

Project Name: Canton Sugar Creek WTP Project Number OH 43702

Rush Authorized by: Project Category: ASB

Special Billing/Reporting:

Is this a VAP project requiring VAP lab analysis? Yes No X

Internal Contact: Bowen

CHAIN OF CUSTODY

Relinquished by		Received by	
Name	Date/Time	Name	Date/Time
Corey Calatic	09/29/20 0920	AHD	9/29/20 10
		[signature]	9/30/20 12:02

EA GROUP CONSULTING DIVISION

REQUEST FOR LABORATORY ANALYSIS - ASBESTOS BULK SAMPLING LOG

Page 1 of 2

Sample No.	Homog. Group	1	2
OH43702-RS-WS1	A	X	
-RS-WS2	A		
ML-CL1	B		
OO-CL2	B		
CR-CL3	B		
ML-CL5	C		
MT-CL6	C		
MT-CL7	C		
MR-PL1	E		
-PL2	E		
-PL3	E		
SR-WS1	F		
SR-WS2	F		
MR-WS1	G		
-WS2	G		
MR-DS1	H		
-DS2	H		
EL-DS1	I		
EL-DS2	I		
EL-WS1	J		

Sample No.	Homog. Group	1	2
OH43702-EL-WS2	J	X	
LL-DS1	K		
-DS2	K		
MG-DS1	L		
-DS2	L		
CL-WS1	M		
-WS2	M		
CL-DS1	N		
-DS4	N		
CL-DS2	O		
-DS3	O		
FL-DS1	P		
-DS2	P		
OG-DS1	Q		
-DS2	Q		
OG-DS3	R		
-DS4	R		
OG-WS1	S		
-WS2	S		
FR2-WS1	T		

Sample No.	Homog. Group	1	2
OH43702-FR2-WS2	T	X	
-FR2-WS3	U		
FR2-WS4	U		
GB-A1	V		
-A2	V		
GB-A3	W		
-A4	W		
GN-LS1	X		
-LS2	X		
GN-DS1	Y		
GN-DS2	Y		
AW-R1	Z		
AW-R4	Z		
AW-R2	AA		
AW-R3	AA		
AW-B1	AB		
-B2	AB		
AW-DS1	AC		
-DS2	AC		
AE-B1	AD		

Analytes: 1 PLM (standard) 2 PLM (full) Point Count: ____ or ALL (enter # or circle ALL)

Hygienist: C Falatko **Sampling Date:** 09/18/20 + 09/25/20

Comments:

EA GROUP CONSULTING DIVISION

REQUEST FOR LABORATORY ANALYSIS - ASBESTOS BULK SAMPLING LOG

Sample No.	Homog. Group	1	2
OH43702-AE-BZ	AD	X	
AE-DS1	AE	↓	
AE-DS2	↓	↓	

Sample No.	Homog. Group	1	2

Sample No.	Homog. Group	1	2

Analytes: 1 PLM (standard) 2 PLM (full) Point Count: ____ or ALL (enter # or circle ALL)

Hygienist: C. Fulato

Sampling Date: 09/25/20 + 09/18/20

Comments:

EA GROUP
Environmental Analysis and Management

Burgess & Niple
100 W. Erie St.
Painesville, OH 44077
Carl Seifried

Client Project: Canton Sugar Creek WTP
EA Group Workorder Number: 200900287
Received on September 29, 2020

The following analytical report contains results as requested for samples submitted to EA Group. The results included in this report have been reviewed for compliance with the analytical methods indicated in this report. All data has been found to be compliant with accepted laboratory protocol, except as noted in the QC narrative. Industrial hygiene reports, air and/or surface concentrations results are based upon sampling information provided by the client. Industrial hygiene results will not be blank corrected. Analyst initials of REF indicate analysis performed at a subcontract facility.

If you have questions, comments or require further assistance regarding this report, please contact your client services representative or one of the individuals listed below.

Data or reporting:
Debbie Lauer - Lab Manager
dlauer@eagroupohio.com

Mike Herbert - General Manager
mherbert@eagroupohio.com

Sample tracking, supplies:
Haley Imler - Sample Control
sreceiving@eagroupohio.com

Invoice Related:
Bonnie Renbarger - Office Manager
brenbarger@eagroupohio.com

EA GROUP
Environmental Analysis and Management

Laboratory Analytical Report

Burgess & Niple

100 W. Erie St.

Painesville, OH 44077

Attention:
Carl Seifried

Client Project:

Canton Sugar Creek WTP

OH43702

EA Group Workorder:
2009-00287

Deborah L. Lauer

Laboratory Manager

October 5, 2020

Sample Receive Date 9/29/2020

Sample Listing

EAG Sample Identification	Client Sample Identification	EAG Sample Identification	Client Sample Identification
200900287 - 001	OH43702-W4-P4	200900287 - 002	OH43702-W4-P5
200900287 - 003	OH43702-W4-P6	200900287 - 004	OH43702-W2-P1
200900287 - 005	OH43702-W2-P2	200900287 - 006	OH43702-W2-P3
200900287 - 007	OH43702-W2-P7	200900287 - 008	OH43702-W9-P8
200900287 - 009	OH43702-W9-P9	200900287 - 010	OH43702-W9-P10
200900287 - 011	OH43702-W9-P11	200900287 - 012	OH43702-W9-P12
200900287 - 013	OH43702-LL-P1	200900287 - 014	OH43702-LL-P2
200900287 - 015	OH43702-LL-P3	200900287 - 016	OH43702-LL-P4
200900287 - 017	OH43702-LL-P5	200900287 - 018	OH43702-LL-P6
200900287 - 019	OH43702-LL-P7	200900287 - 020	OH43702-LL-P8
200900287 - 021	OH43702-LL-P9	200900287 - 022	OH43702-PG-P5
200900287 - 023	OH43702-PG-P6	200900287 - 024	OH43702-PG-P7
200900287 - 025	OH43702-PG-P8	200900287 - 026	OH43702-PG-P9
200900287 - 027	OH43702-PG-P10	200900287 - 028	OH43702-FR2-P1
200900287 - 029	OH43702-FR2-P2	200900287 - 030	OH43702-ER-P1
200900287 - 031	OH43702-ER-P2	200900287 - 032	OH43702-ER-P3
200900287 - 033	OH43702-ER-P4	200900287 - 034	OH43702-AW-P1
200900287 - 035	OH43702-AW-P2	200900287 - 036	OH43702-AE-P1
200900287 - 037	OH43702-AE-P2	200900287 - 038	OH43702-P2-P1
200900287 - 039	OH43702-P2-P2	200900287 - 040	OH43702-P2-P3
200900287 - 041	OH43702-P2-P4	200900287 - 042	OH43702-P3-P5
200900287 - 043	OH43702-P3-P6	200900287 - 044	OH43702-P3-P7
200900287 - 045	OH43702-P3-P8	200900287 - 046	OH43702-P4-P9
200900287 - 047	OH43702-P4-P10	200900287 - 048	OH43702-P4-P11
200900287 - 049	OH43702-MP-P12	200900287 - 050	OH43702-MP-P13
200900287 - 051	OH43702-ST-P14	200900287 - 052	OH43702-ST-P15
200900287 - 053	OH43702-SC-P17	200900287 - 054	OH43702-SC-P18
200900287 - 055	OH43702-DR-P19	200900287 - 056	OH43702-DR-P20
200900287 - 057	OH43702-CL-P1	200900287 - 058	OH43702-CL-P2
200900287 - 059	OH43702-FL-P1	200900287 - 060	OH43702-FL-P2
200900287 - 061	OH43702-FL-P3	200900287 - 062	OH43702-OO-P1
200900287 - 063	OH43702-CR-P2	200900287 - 064	OH43702-CR-P3
200900287 - 065	OH43702-CR-P4	200900287 - 066	OH43702-OG-P1

EA GROUP
Environmental Analysis and Management

Project Narrative
2009-00287

All analyses performed by EA Group were done using established laboratory SOPs. Management has reviewed the data for compliance with the laboratory QA/QC plan and data have been found to be compliant with the laboratory protocols unless otherwise noted below. All results listed for this report relate only to the samples submitted on this work order.

The temperature of the sample(s) upon receipt was 25°C.

Misc. QC Comments

Percent Moisture is used to report results on a dry weight basis.

When necessary, reporting limits of individual samples may be raised due to high concentration of interfering compounds or target analytes, or quantity of sample available for analysis.

pH method note: If this analysis was performed in the laboratory, it may not meet the "immediate analysis" requirement that applies to most wastewater monitoring samples. In such cases, analysis for pH should be done at the time of sampling.

The results listed in this report relate only to the samples submitted to EA Group per the chain of custody.

Data Flag Table

B	The method blank contained a standard laboratory contaminant (Methylene Chloride, Acetone, Hexane, Phthalates, etc.) above the standard laboratory method detection limit. If the analyte is present in the sample at a concentration up to ten times the blank level, the result is reported with a "B" indicating method blank contamination. Samples will be reported without a "B" if the analyte concentration in the sample is greater than ten times the blank level.
E	An analytical result marked with an "E" indicates the result reported is above the high end limit of the calibration curve and should be considered an estimated concentration.
DIL	Due to matrix interference or high analyte concentration, a dilution was required. The spikes and/or surrogates results could not be quantitated and therefore marked "DIL".
J	An analytical result marked with a "J" indicates the result reported was below the standard reporting limit and above the method detection limit. As the observed level approaches the MDL there is an increasing probability of a false positive response.
MI	Analytical results marked as "MI" indicate that due to inherent matrix interference, the result could not be quantitated.
#	Results flagged "#" indicate the reported result may be outside allowable permit levels as provided by the client, when applicable.
NA	A result or field marked as "NA" indicates that it was not applicable for this project.
Q	A quality control result flagged with a "Q" indicates the percent recovery was outside the acceptable range as determined by the laboratory.

** Positive results for this analyte represent a probable combination of 3-Methylphenol (m-Cresol) and 4-Methylphenol (p-Cresol).

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-W4-P4 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-1

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**310**	220	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W4-P5 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-2

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**2400**	340	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W4-P6 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-3

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**10400**	470	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W2-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-4

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**29400**	1100	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W2-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-5

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**390**	125	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W2-P3 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-6

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**160**	120	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W2-P7 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-7

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**2040**	80	mg/kg	10/01/2020	10/02/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-W9-P8 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-8

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**22000**	1300	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W9-P9 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-9

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**226**	45	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W9-P10 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-10

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**200**	76	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W9-P11 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-11

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<61	61	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-W9-P12 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-12

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**152**	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-13

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-14

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-LL-P3 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-15

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P4 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-16

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P5 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-17

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P6 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-18

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P7 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-19

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P8 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-20

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-LL-P9 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-21

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<96	96	mg/kg	10/01/2020	10/02/2020		CMB

EA GROUP
Environmental Analysis and Management

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-PG-P5 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-22

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**404**	62	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-PG-P6 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-23

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1550**	54	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-PG-P7 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-24

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**876**	47	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-PG-P8 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-25

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-PG-P9 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-26

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1540**	48	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-PG-P10 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-27

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-FR2-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-28

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<68	68	mg/kg	10/01/2020	10/02/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-FR2-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-29

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**350**	66	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-ER-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-30

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**360**	110	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-ER-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-31

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1000**	150	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-ER-P3 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-32

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<96	96	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-ER-P4 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-33

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<110	110	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-AW-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-34

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**210**	125	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-AW-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-35

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**58**	53	mg/kg	10/01/2020	10/02/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-AE-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-36

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1100**	48	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-AE-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-37

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<71	71	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-P2-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-38

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**140**	48	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-P2-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-39

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<110	110	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-P2-P3 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-40

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**410**	180	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-P2-P4 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-41

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**140**	38	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-P3-P5 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-42

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**44**	34	mg/kg	10/01/2020	10/05/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-P3-P6 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-43

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**89**	32	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-P3-P7 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-44

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**2200**	110	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-P3-P8 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-45

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**41.5**	25	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-P4-P9 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-46

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<64	25	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-P4-P10 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-47

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1200**	230	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-P4-P11 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-48

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**67.8**	25	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-MP-P12 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-49

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/05/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-MP-P13 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-50

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**3010**	120	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-ST-P14 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-51

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**11400**	1900	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-ST-P15 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-52

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**4900**	240	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-SC-P17 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-53

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1410**	54	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-SC-P18 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-54

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1660**	78	mg/kg	10/01/2020	10/02/2020		CMB

Client ID: OH43702-DR-P19 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-55

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**200**	76	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-DR-P20 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-56

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1700**	190	mg/kg	10/01/2020	10/02/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-CL-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-57

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-CL-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-58

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**5420**	870	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-FL-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-59

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-FL-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-60

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<28	28	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-FL-P3 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-61

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-OO-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-62

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<61	61	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-CR-P2 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-63

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**370**	150	mg/kg	10/01/2020	10/05/2020		CMB

EAG Workorder: 2009-00287

Client Project: Canton Sugar Creek WTP

Client ID: OH43702-CR-P3 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-64

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	<25	25	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-CR-P4 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-65

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**1140**	65	mg/kg	10/01/2020	10/05/2020		CMB

Client ID: OH43702-OG-P1 **Date/Time Sampled:** **Received:** 9/30/2020
EAG ID: 2009-00287-66

Parameter	CAS #	Result	Reporting Limit	Units	Prep Date	Analysis Date	Time	Analyst
Lead in Paint: SW846-6010B	7439-92-1	**114**	71	mg/kg	10/01/2020	10/05/2020		CMB

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FIELD REQUEST FOR LABORATORY ANALYSIS

Company Name: Burgess + Niple

Address: _____

_____

Attention: Mr Carl Seifried

Customer Number: 0011236

Telephone: _____ e-mail: _____

Sampled by: G Falatic

Project Name: Canton Sugar Creek WTP Project Number OH 43702

Rush Authorized by: _____ Project Category: Asb/ENV

Special Billing/Reporting: _____

_____

Is this a VAP project requiring VAP lab analysis? Yes _____ No _____

Is this a BUSTR project requiring BUSTR lab analysis? Yes _____ No _____

Internal Contact: _____

Results Needed By: _____

Normal: X **RUSH:** _____

Priority: _____ (confirm w/ lab)

Date: _____ Time: _____

CHAIN OF CUSTODY

Relinquished by			Received by		
Name		Date/Time	Name		Date/Time
Gary Falatic		09/29/20 0930			9/30/20 11:41

EA GROUP FIELD OPERATIONS - REQUEST FOR LABORATORY ANALYSIS

Page: 1 of 4

Sample No. OH 43702	Split ID	Date/Time Collected	Matrix/ Media	Area/Vol. (units)	1	2	3	4	5	6	7	8	9	Comments	VAP? BUSTR?
-W4-P4		09/19/20	B	1 sq in	X										
-P5															
-P6															
W2-P1															
-P2															
-P3															
-P7															
W9-P8															
-P9															
-P10															
-P11															
-P12															
LL-P1															
-P2															
-P3															
-P4															
-P5															
-P6															
-P7															
-P8															

Media:

A1	Air (25 mm)	A6	Air (impinger)	SL	Sludge/Slurry
A2	Air (37 mm)	B	Bulk	SW	Swab
A3	Air (sorbent)	R/CC	Char. Canister	O	Oil
A4	Air (badge)	R/AT	Alpha track	W	Water/Liquid
A5	Air (bag)	S	Soil	DW	Drinking Water

Sample condition upon receipt:
Intact ___
Not Intact ___

Analytes:
1 Lead in Paint
2 ___
3 ___
4 ___
5 ___
6 ___
7 ___
8 ___
9 ___

EA GROUP FIELD OPERATIONS - REQUEST FOR LABORATORY ANALYSIS

Page: 2 of 4

Sample No. OH 43702	Split ID	Date/Time Collected	Matrix/ Media	Area/Vol. (units)	1	2	3	4	5	6	7	8	9	Comments	VAP? BUSTR?
-LL-P9		09/18/20	B	1 sq in	X										
PG-P5															
-P6															
-P7															
-P8															
-P9															
-P10															
FR2-P1															
-P2															
ER-P1															
-P2															
-P3															
-P4															
AW-P1															
-P2															
AE-P1															
-P2															
P2-P1															
-P2															
-P3															

Media:
A1 Air (25 mm)
A2 Air (37 mm)
A3 Air (sorbent)
A4 Air (badge)
A5 Air (bag)
A6 Air (impinger)
B Bulk
R/CC Char. Canister
R/AT Alpha track
S Soil
SL Sludge/Slurry
SW Swab
O Oil
W Water/Liquid
DW Drinking Water

Sample condition upon receipt:
Intact ___
Not Intact ___

Analytes:
1 Lead in Paint
2 ___
3 ___
4 ___
5 ___
6 ___
7 ___
8 ___
9 ___

EA GROUP FIELD OPERATIONS - REQUEST FOR LABORATORY ANALYSIS

Sample No. OH 43702	Split ID	Date/Time Collected	Matrix/ Media	Area/Vol. (units)	1	2	3	4	5	6	7	8	9	Comments	VAP? BUSTR?
-P2-P4		09/25/20	B	1 sq in	X										
-P3-P5															
-P6															
-P7															
-P8															
P4-P9															
-P10															
-P11															
MP-P12															
-P13															
ST-P14															
ST-P15															
SC-P17															
-P18															
AR-P19															
-P20															
CL-P1															
-P2															
FL-P1															
-P2															

Media:

A1	Air (25 mm)	A6	Air (impinger)	SL	Sludge/Slurry
A2	Air (37 mm)	B	Bulk	SW	Swab
A3	Air (sorbent)	R/CC	Char. Canister	O	Oil
A4	Air (badge)	R/AT	Alpha track	W	Water/Liquid
A5	Air (bag)	S	Soil	DW	Drinking Water

Sample condition upon receipt:
Intact ___
Not Intact ___

Analytes:
1 Lead in Paint
2 ___
3 ___
4 ___
5 ___
6 ___
7 ___
8 ___
9 ___

EA GROUP FIELD OPERATIONS - REQUEST FOR LABORATORY ANALYSIS

Page: 4 of 4

Sample No. OH 43702	Split ID	Date/Time Collected	Matrix/ Media	Area/Vol. (units)	1	2	3	4	5	6	7	8	9	Comments	VAP? BUSTR?
-FL-P3		09/25/20	B	1 gal	X										
OD-P1															
CR-P2															
-P3															
-P4															
OE-P1															

Media: A1 Air (25 mm); A2 Air (37 mm); A3 Air (sorbent); A4 Air (badge); A5 Air (bag); A6 Air (impinger); B Bulk; R/CC Char. Canister; R/AT Alpha track; S Soil; SL Sludge/Slurry; SW Swab; O Oil; W Water/Liquid; DW Drinking Water

Sample condition upon receipt:
Intact ___
Not Intact ___

Analytes: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ 9 _____

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APPENDIX III - CONCRETE WATER RESERVOIR INSPECTION REPORTS

Video files available upon request

Existing Plant Designation: Washwater Reservoir

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK BACKWASH Date: 10/18/2021

Inspector: E. BOMBERGER Dive Controller: G. ROMPF Capacity: 156.5 KG Dimentions: 45'L X 45'W X 10'H

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R, E, B	R, B	R, B	R, B
~~Expansion Joint(s)~~				
Support Beam(s)	R, B	R, B	R, B	R, B
Beam Joint(s)	R	R	R	R

General Appearance: Good Coating: N/A

~~All expansion joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

INTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	R	R	R	R
Wall Structure	R, B	R, B	R, B	R, B

General Appearance: Good Coating: N/A Leaking: None observed

INTERIOR RESERVOIR SUPPORT COLUMNS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Columns	R, B	R, B	R, B	R, B
Column Capitals	R, B	R	R	R
Column Bases	R	R	R	R

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A Sump System: Good Leaking: None observed

~~All expansion joints: Uniform width: Uniform Level: Gaskets Intact:~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK BACKWASH

Inspector: E. BOMBERGER | Dive Controller: G. ROMPF | Date: 10/18/2021

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	N/A	------	5	Significant	N/A	------
Outlet Plumbing	N/A	------	N/A	------	5	Significant	N/A	------
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Other Plumbing~~	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☐ Staining ☐ Sags/Runs

Over All Coating Condition ---- Average Blister Size NONE

Over All Structural Condition Good Weld Condition ---- Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4

EXTERIOR RESERVOIR ROOF

Roof Slab(s)	UNABLE TO EVALUATE →	→	→	→
Expansion Joint(s)	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ Coating: N/A Vents: Good Level Indicator: N/A

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

Wall-Roof Joint	UNABLE TO EVALUATE →	→	→	→
Wall Structure	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ Coating: N/A Leaking: None observed

Overflow Structure: ------

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

Perimeter Joint	UNABLE TO EVALUATE →	→	→	→
Footing Ring	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ Coating: N/A Leaking: None observed Ground Subsidence: None observed

All expansion Joints Uniform Width: ------ Uniform Level: ------ Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK BACKWASH

Inspector: E. BOMBERGER | Dive Controller: G. ROMPF | Date: 10/18/2021

FACILITY SAFETY & HEALTH

Primary Air Vent	Type: J-Tube	Screen : Good	Pressure Vacuum / Frost Proof: Yes		
Exterior Overflow	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#: N/A	Properly Sealed: ----	
Water Level Indication	Type: ----	Condition: ----	Pennetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Square	Size: 24 X 24	in. (24" - 24" x 15" min)	Properly Sealed: No	
Hatch Height: 2	in. (min 4")	Lid Height: 1.25	in (min 2")	Properly Secured: No	
2nd Access Hatch	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

Primary Manway

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size:	in (24" - 18"x22")		
Support Structure	Type: -------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

Primary Exterior Ladder

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Overall Ladder	Condition: ----	Height:	Offset Landing: ----		
Vandal Guard	Present: ----	Locked: ----			
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----		
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")	
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail: in. (min 16")
Safety Climb System	Type: ------	Condition: ----			

Primary Balcony & Railing

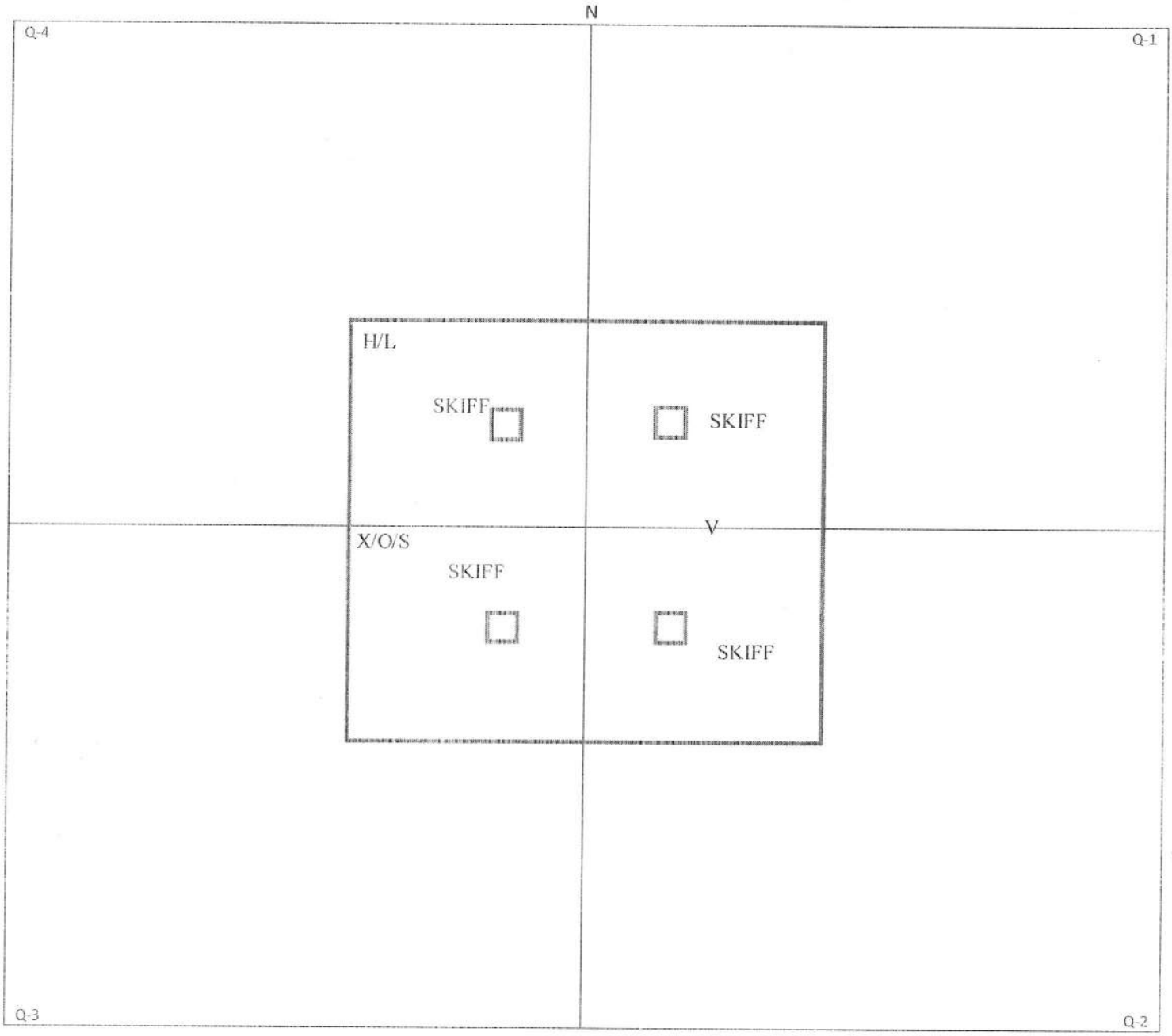
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: ----	Cracking: ----	Standing Water: ----	Other: UNABLE TO EVALUATE
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE
Safety Tie-Off Points	Type: ----		#:	Condition: ----
Antennas	Type: ----		#: Location(s): Roof:	Bowl: Leg: Other:
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE
Hypalon Floating Cover	Condition: ----		Holes: ----	Tears: ----
Grounding System	Present: No			

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK BACKWASH



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth SKIFF **Cubic Yardage** **Sediment Type** IRON /MANGANESE

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------

N

SEE ABOVE DIAGRAM

Liquid Engineering Corporation

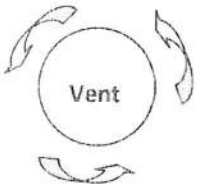
Potable Water Reservoir Security / Measurement Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK BACKWASH

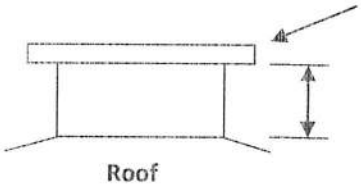
Security

Is the area surrounding the tank well lit?	No
Is the tank surrounded by a Security Fence?	No
Are the access gates locked?	N/A
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

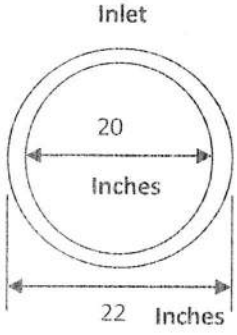
Measurements

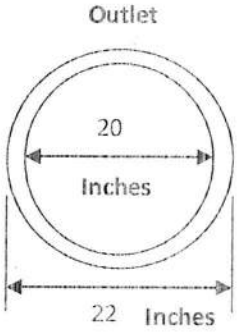


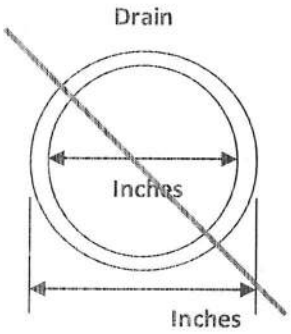
Outside Circumference
29 Inches

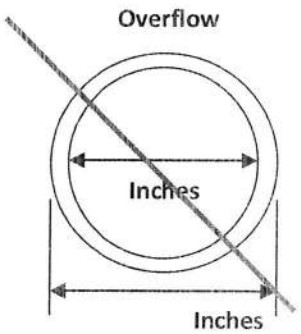


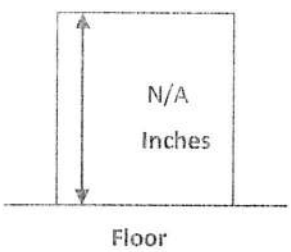
Flange Metal Thickness	1	Inches
Roof to Screen or Flange	24	Inches
Flange	Yes	
Number of Bolt Holes	8	Inches
Size of Bolts	5/8	Inches

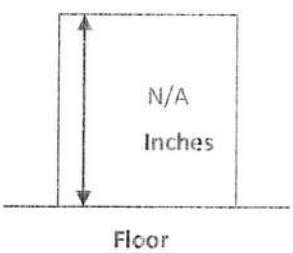


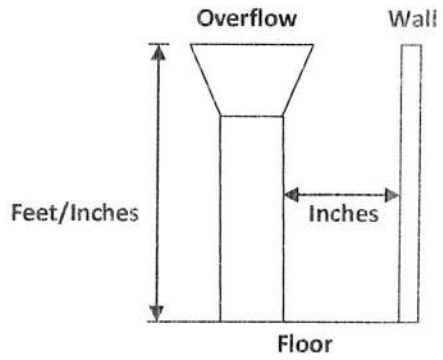












Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK BACKWASH

Inspector: E. BOMBERGER | Dive Controller: G. ROMPF | Date: 10/18/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☑ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon entering the reservoir, the diver noted a "skiff" of iron/manganese sediment covering a majority of the floor in all quadrants. Areas of the floor that were visible, the diver found the floor slabs to be in good condition, with only staining noted. Along the Western wall, the diver located a large sump are which contains what appears to be the common inlet/outlet. The common inlet/outlet appears to be free of obstruction, but does have a significant amount of corrosion/tubercles on the inside. There are four (4) support columns within the reservoir, all of which exhibit staining and bug holing, with no cracking or spalling noted. Throughout all quadrants of the walls, staining and bug holing was also observed. The diver did not identify any areas of cracking and leaking on the wall slabs. The internal ladder exhibits extensive intergranular corrosion, which has weakened the durability of the rungs. In all quadrants of the roof, staining and bug holing was noted, as well as some minor efflorescence that was located in Quadrant 1. The roof support beams also exhibit staining and bug holing, without any cracking or spalling being identified. Extensive corrosion was observed on the vent, which was found to be intact and properly screened. Although extensive corrosion was found on the access hatch, it was found to be in relatively good condition. It is recommended that the access hatch as a locking mechanism installed, for added security.
Liquid Engineering Corporation recommends that this reservoir be cleaned and inspected every 5 years.

Existing Plant Designation: Chlorination Chamber

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK CHLORINE Date: 10/14/2021

Inspector: E. BOMBERGER Dive Controller: Capacity: 65 KG Dimentions: 22'L X 23'W X 18'H

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR ROOF				
Roof Slab(s)	R, B, C, E	R, B, C, E	R, B, C, E	R, B, C, E
~~Expansion Joint(s)~~				
~~Support Beam(s)~~				
~~Beam Joint(s)~~				
INTERIOR RESERVOIR WALLS				
Wall-Roof Joint	R, E	R, E	R, E	R, E
Wall Structure	R, B	R, B	R, B	R, B
~~INTERIOR RESERVOIR SUPPORT COLUMNS~~				
Columns				
Column Capitals				
Column Bases				
INTERIOR RESERVOIR FLOOR				
Perimeter Joint	R	R	R	R
Floor Slabs	R	R, M	R	R

General Appearance: Good Coating: N/A

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

General Appearance: Good Coating: N/A Leaking: None observed

General Appearance: ------ Coating: N/A

General Appearance: Good Coating: N/A Sump System: Good Leaking: None observed

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CHLORINE

Inspector: E. BOMBERGER | Dive Controller: | Date: 10/14/2021

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	2	Significant	N/A	------	N/A	------
Outlet Plumbing	N/A	------	N/A	------	N/A	------	2	Significant
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
Other Plumbing	N/A	------	3	Significant	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☐ Staining ☐ Sags/Runs

Over All Coating Condition Poor | Average Blister Size NONE

Over All Structural Condition Fair | Weld Condition ---- | Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R, C	R, C	R, C	R, C
~~Expansion Joint(s)~~				

General Appearance: Good | Coating: N/A | ~~Vents:~~ | ~~Level Indicator:~~

~~All expansion Joints~~ ~~Uniform width:~~ ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

Wall-Roof Joint	UNABLE TO EVALUATE →	→	→	→
Wall Structure	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: None observed

Overflow Structure: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

Perimeter Joint	UNABLE TO EVALUATE →	→	→	→
Footing Ring	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: None observed | Ground Subsidence: None observed

All expansion Joints | Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CHLORINE

Inspector: E. BOMBERGER | Dive Controller: | Date: 10/14/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#: N/A	Properly Sealed: ----	
Water Level Indicatior	Type: Electronic	Condition: Good	Pennetration Points	Properly Sealed: Yes	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Other	Size: 24 X 46	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 2	in. (min 4")	Lid Height: 2	in (min 2")	Properly Secured: No	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: -------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

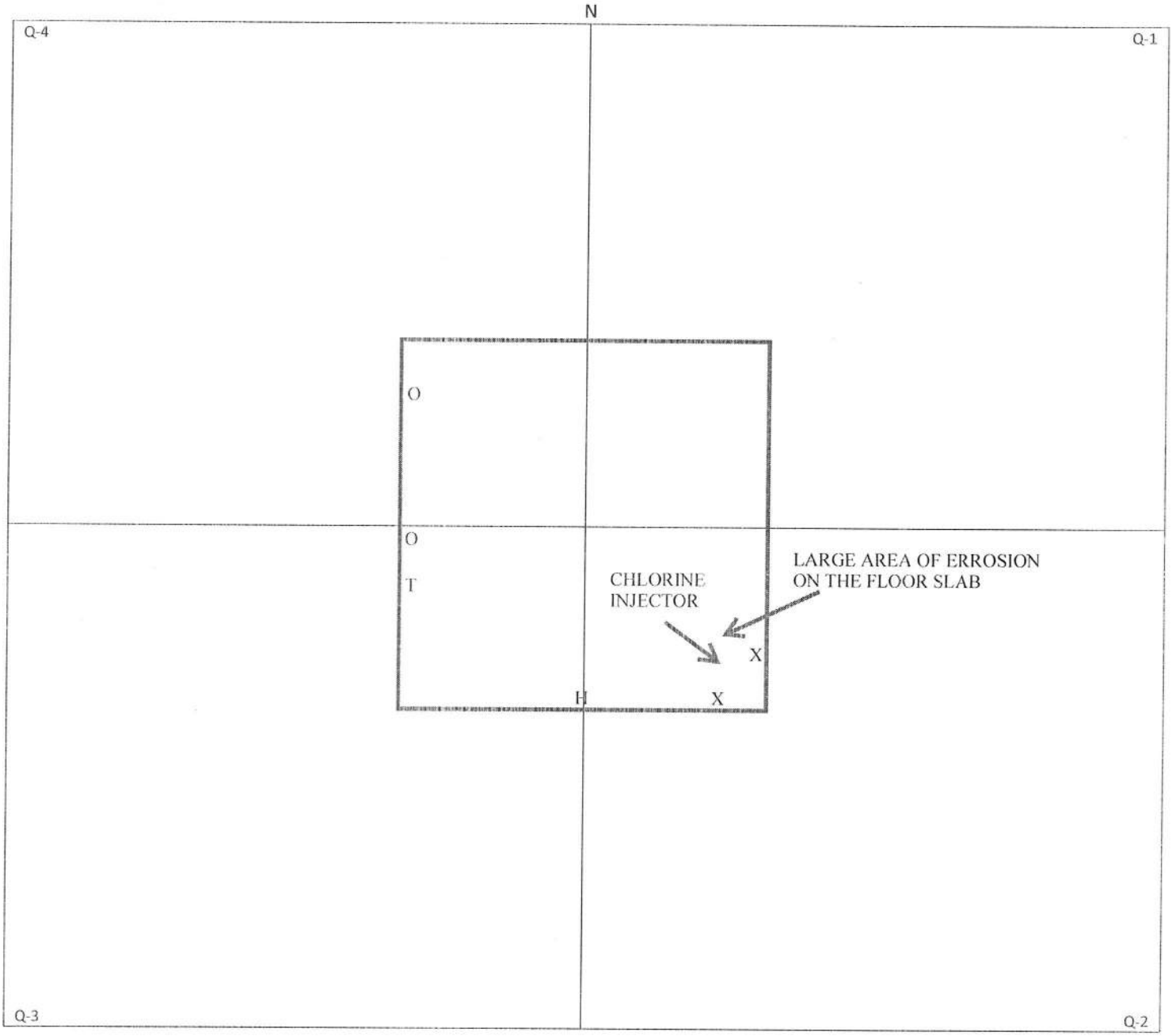
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:	
Deck / Walkways	Condition: ----	Width:	in. (min 24")		
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----	
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)		
Toe Boards	Condition: ----	Height:	in. (min 4")		

Roof Integrity:	Holes: No	Cracking: Yes	Standing Water: No	Other:		
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE		
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----		
~~Antennas~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg: Other:
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE		
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----		
Grounding System	Present: No					

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CHLORINE



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth **Cubic Yardage** **Sediment Type**

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

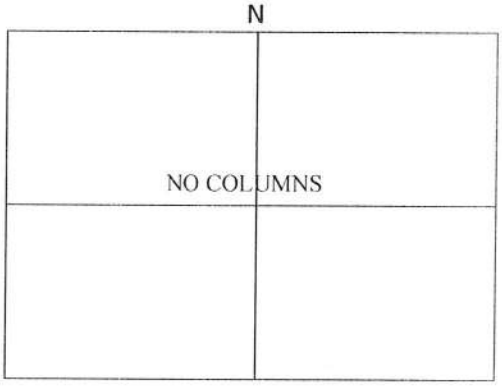
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

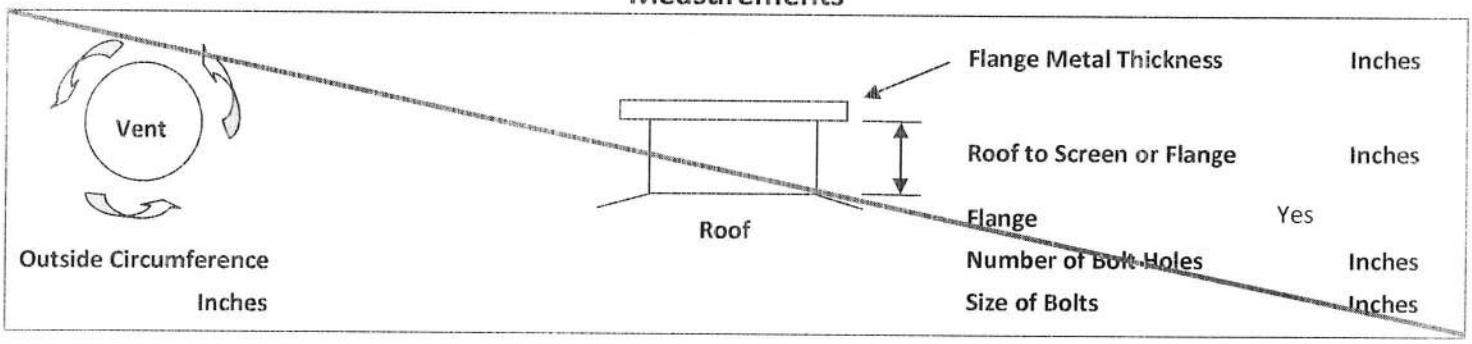
Potable Water Reservoir Security / Measurement Worksheet

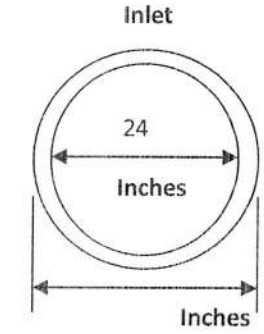
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CHLORINE

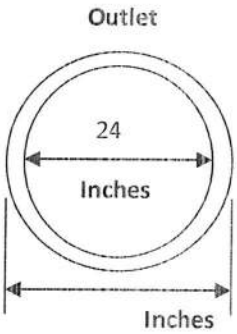
Security

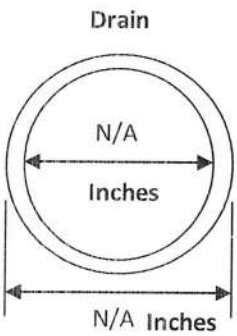
Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

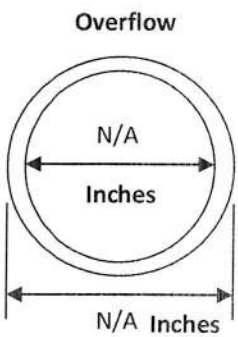
Measurements

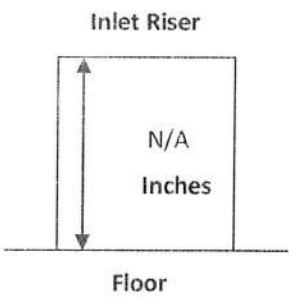


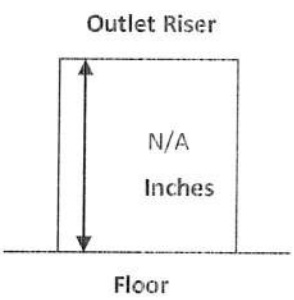


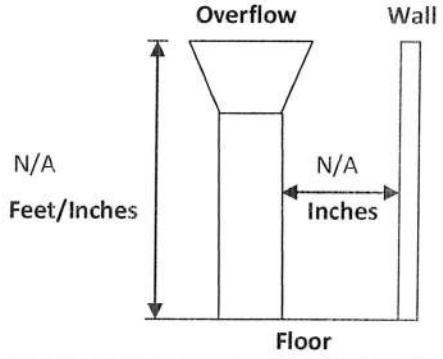












Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CHLORINE

Inspector: E. BOMBERGER | Dive Controller: | Date: 10/14/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon entering the reservoir, the diver noted a very light "skiff" of sediment on the floor in all quadrants. Throughout all quadrants of the floor, staining and adhered sediment was observed. The diver did note a large hole in the floor of Quadrant 2, which appears to be errosion from the injection of chlorine. This "hole" does not appear to be allowing any leakage, but should be closely monitored until it can be filled in. Along the Western wall, the floor slopes down, to where the two outlets are located. These outlets allow water to flow into the Pump 1 and 2 reservoir. In the Southeast corner, the inlets were identified. Both of the inlets allow water into the chlorine chamber from Clearwell 1B and Clearwell 2. All four (4) of the 24" butterfly valves exhibit extensive corrosion and buildup, which does not appear to be preventing the valves from opening/closing as needed. The housing for the valve stems also exhibit extensive intergranular corrosion. The chlorine injection port was found to be intact, and is mostly constructed of 2" PVC. The metal portion of the injector port does have extensive corrosion however. Throughout all quadrants of the walls, bug holing and staining was noted. The diver did not identify any cracking or suspected leaking on the walls. Minor hairline cracks were found in all quadrants of the roof slabs, which are accompanied by efflorescence. Light staining and bug holing was also observed in all quadrants of the roof. Corrosion was noted on the access hatch, but did appear to be intact and properly sealed.
Liquid Engineering Corporation recommends that this reservoir be inspected every 5 years.

Existing Plant Designation: Clearwell 1A

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK CLEARWELL 1A Date: 10/15/2021

Inspector: G. MOMMAERTS Dive Controller: E. BOMBERGER Capacity: 205KG Dimentions: 80' L X 20' W

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR ROOF				
Roof Slab(s)	R	R	R	R
~~Expansion Joint(s)~~				
Support Beam(s)	R, E	R, E	R, E	R, E
Beam Joint(s)	R	R	R	R

General Appearance: Good Coating: N/A

~~All expansion Joints: Uniform width: ------~~ Uniform Level: ------ ~~Gaskets Intact: ------~~

INTERIOR RESERVOIR WALLS				
Wall-Roof Joint	R	R	R	R
Wall Structure	R, B	R, B	R, B	R, B

General Appearance: Good Coating: N/A Leaking: None observed

~~INTERIOR RESERVOIR SUPPORT COLUMNS~~				
Columns				
Column Capitals				
Column Bases				

General Appearance: ------ Coating: N/A

INTERIOR RESERVOIR FLOOR				
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A ~~Sump System: ------~~ Leaking: None observed

~~All expansion Joints: Uniform width: ------~~ Uniform Level: ------ ~~Gaskets Intact: ------~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b
Utility: CANTON WATER DEPARTMENT
Tank: SUGARCREEK CLEARWELL 1A
Inspector: G. MOMMAERTS
Dive Controller: E. BOMBERGER
Date: 10/15/2021

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	2	Significant	N/A	------	N/A	------
Outlet Plumbing	8	Minor	N/A	------	N/A	------	N/A	------
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Other Plumbing~~	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Poor Average Blister Size NONE

Over All Structural Condition Fair Weld Condition Fair Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	UNABLE TO EVALUATE →	→	→	→
Expansion Joint(s)	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ Coating: N/A Vents: ------ Level Indicator: ------

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	UNABLE TO EVALUATE →	→	→	→
Wall Structure	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ Coating: N/A Leaking: ------

Overflow Structure: ------

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	UNABLE TO EVALUATE →	→	→	→
Footing Ring	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ Coating: N/A Leaking: ------ Ground Subsidence: ------

All expansion Joints Uniform Width: ------ Uniform Level: ------ Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 1A

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/15/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#:	Properly Sealed: ----	
Water Level Indicatior	Type: Electronic	Condition: Good	Pennetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Square	Size: 55 X 49	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 5	in. (min 4")	Lid Height: 2	in (min 2")	Properly Secured: Yes	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: -------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

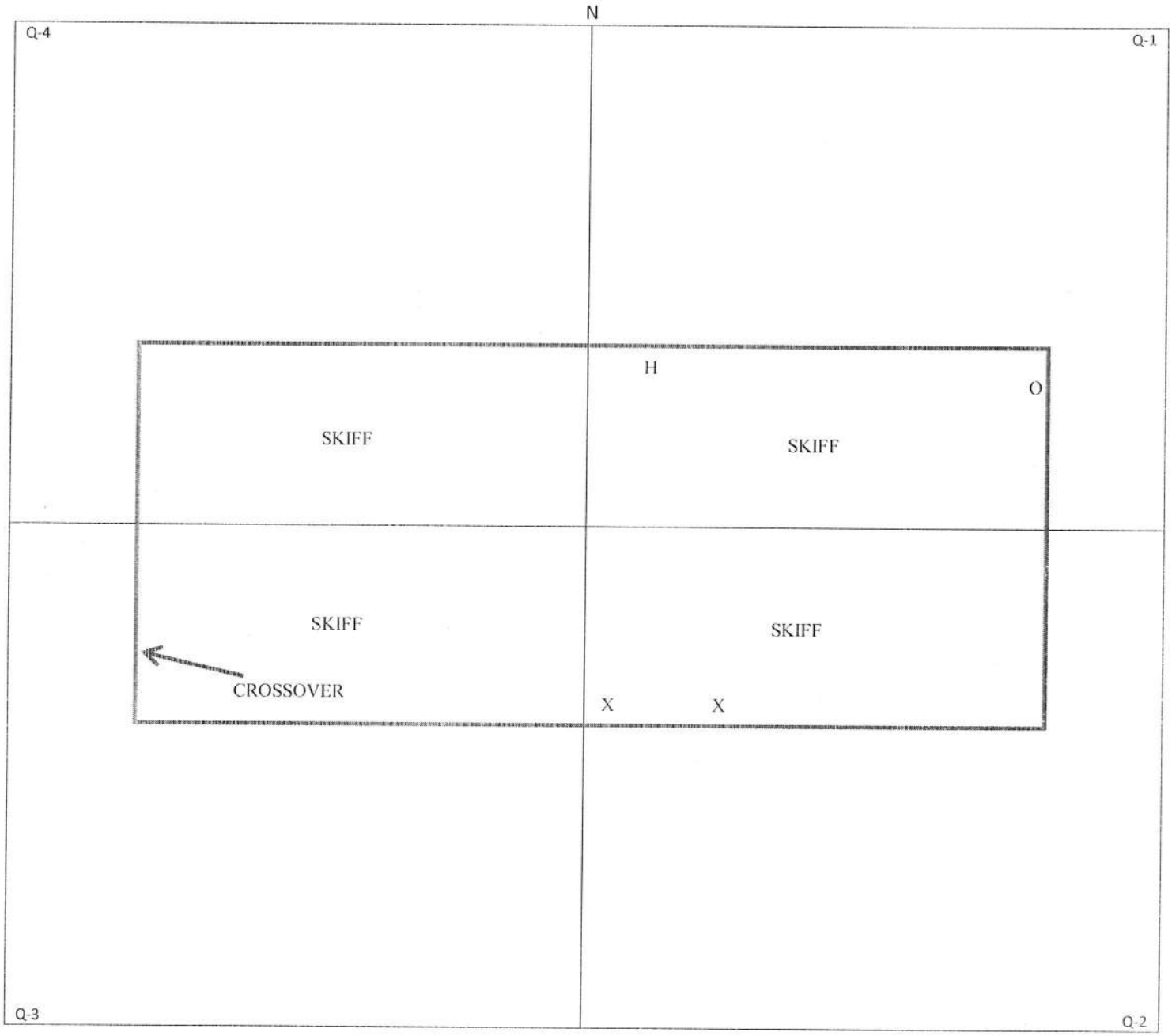
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: ----	Cracking: ----	Standing Water: ----	Other: UNABLE TO EVALUATE			
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE			
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----			
~~Antennas~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg:	Other:
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE			
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----			
Grounding System	Present: No						

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

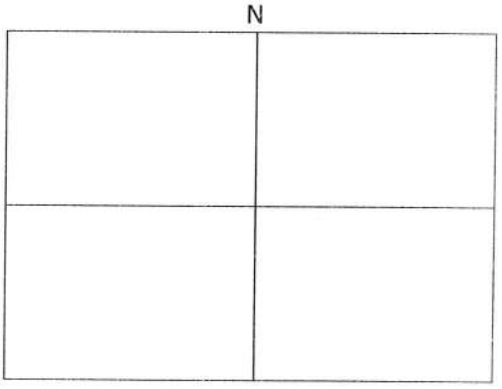
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 1A



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth **Cubic Yardage** **Sediment Type**



Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------

Liquid Engineering Corporation

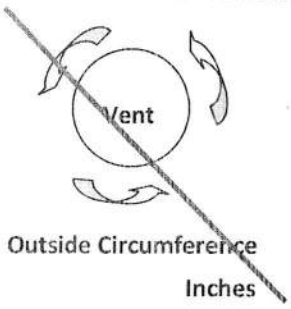
Potable Water Reservoir Security / Measurement Worksheet

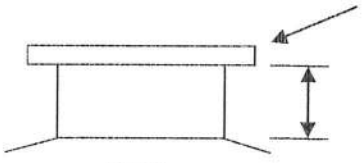
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 1A

Security

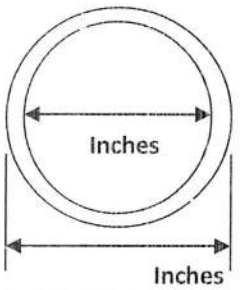
Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

Measurements

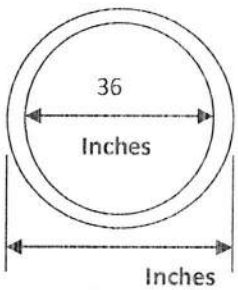


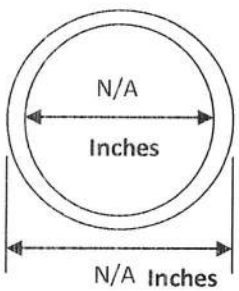


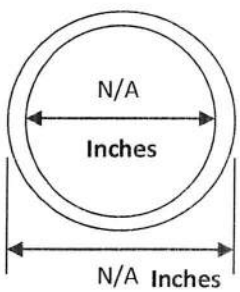
Flange Metal Thickness	N/A	Inches
Roof to Screen or Flange	N/A	Inches
Flange	N/A	
Number of Bolt Holes	N/A	Inches
Size of Bolts	N/A	Inches

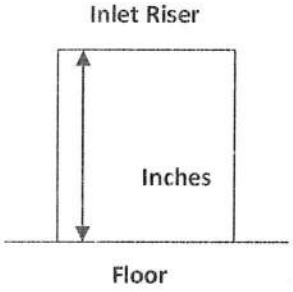


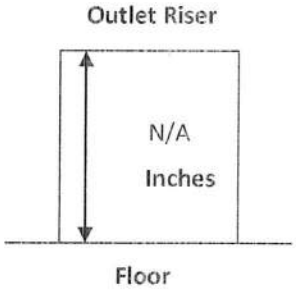
UNABLE TO OBTAIN MEASUREMENTS

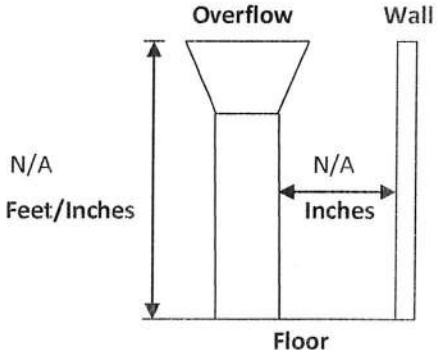












Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 1A

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/15/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon reaching bottom the diver noted there was very little sediment, so the diver was able to get a good look at the floor. The floor itself was found to be in good condition with only staining and adhered sediment throughout. The floor to wall joint was also found to be in good condition. The lower walls have some staining, adhered sediment and bug holing but are in good condition otherwise. The upper walls have some staining and bug holing but are in good condition. The wall to roof joint was found to be in good condition with no discrepancies noted. The roof supports and roof slabs have some staining and minor bug holing through all quadrants. There are 2 inlets for this reservoir and they are located in quadrant 2 along the southern wall. There was no flow at the time of inspection but it was found to be heavily corroded on all surfaces otherwise they are unobstructed and in good working order. The outlet for the reservoir is located in quadrant 1. While there is no valve on the outlet plumbing it is unobstructed and in good condition with only minor staining and adhered sediment on the interior. There is also a cross-over plumbing located in quadrant 3. It has some surface level corrosion but is in good condition. The access hatch has no discrepancies at this time and provides good unobstructed access to your reservoir. Overall this reservoir is in good condition.
Liquid Engineering recommends a cleaning and inspection every 3 to 5 years.

Existing Plant Designation: Clearwell 1B

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK CLEARWELL 3A Date: 10/15/2021

Inspector: G. MOMMAERTS Dive Controller: E. BOMBERGER Capacity: 89,300 GAL. Dimentions: 35'L X 20'W X 18'H

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR ROOF				
Roof Slab(s)	R, B	R, B, E	R, B	R, B
~~Expansion Joint(s)~~				
Support Beam(s)	R, B	R, B, E	R, B	R, B
Beam Joint(s)	R	R	R	R

General Appearance: Good Coating: N/A

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR WALLS				
Wall-Roof Joint	R, E	R, E	R, E	R, E
Wall Structure	R, B	R, B, E	R, B	R, B

General Appearance: Good Coating: N/A Leaking: None observed

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
~~**INTERIOR RESERVOIR SUPPORT COLUMNS**~~				
Columns				
Column Capitals				
Column Bases				

General Appearance: ------ Coating: N/A

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR FLOOR				
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A ~~Sump System: ------~~ Leaking: None observed

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 3A

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/15/2021

SSPC Rating	
Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating	
Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating	
Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	N/A	------	3	Significant	N/A	------
Outlet Plumbing	N/A	------	9	Minor	N/A	------	N/A	------
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
Other Plumbing	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☑ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Poor | Average Blister Size NONE

Over All Structural Condition Fair | Weld Condition Good | Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	UNABLE TO EVALUATE	→	→	→
Expansion Joint(s)	UNABLE TO EVALUATE	→	→	→

General Appearance: ------ | Coating: N/A | ~~Vents: ------~~ | Level Indicator: N/A

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	UNABLE TO EVALUATE	→	→	→
Wall Structure	UNABLE TO EVALUATE	R, C, E	R, C, E	R, C, E

General Appearance: Good | Coating: N/A | Leaking: None observed

~~Overflow Structure: ------~~

~~All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------~~

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	UNABLE TO EVALUATE	→	→	→
Footing Ring	UNABLE TO EVALUATE	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: None observed | Ground Subsidence: None observed

All expansion Joints | Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 3A

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/15/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#: N/A	Properly Sealed: ----	
Water Level Indicatior	Type: Pressure	Condition: Good	Pennetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Other	Size: 42 X 36	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 9.5	in. (min 4")	Lid Height: 3	in (min 2")	Properly Secured: Yes	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: -------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

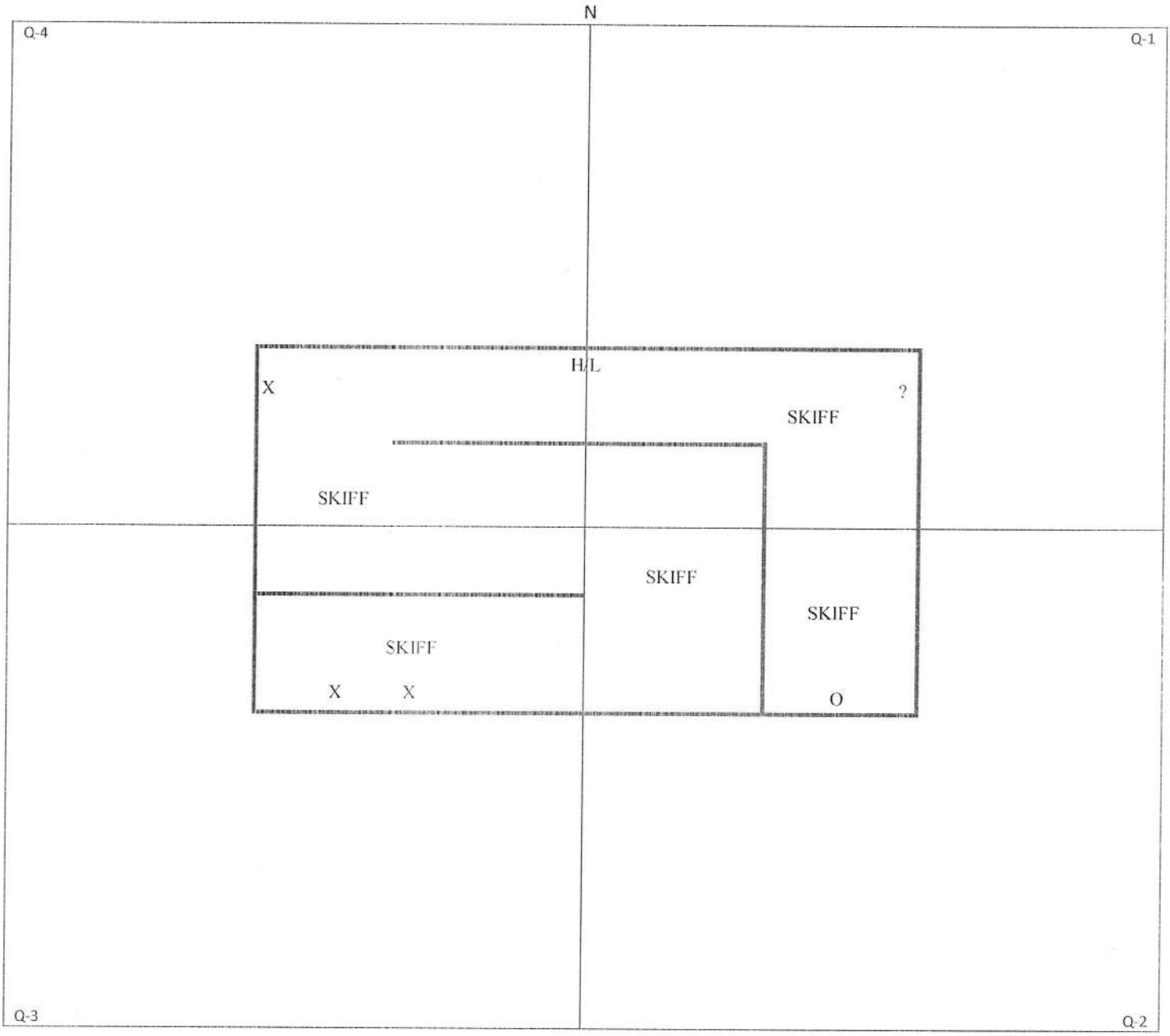
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: ----	Cracking: ----	Standing Water: ----	Other: UNABLE TO EVALUATE		
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE		
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----		
~~Antennas~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg: Other:
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE		
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----		
Grounding System	Present: No					

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 3A



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth **Cubic Yardage** **Sediment Type**

Plumbing & Structure location

Plumbing and structure codes
O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

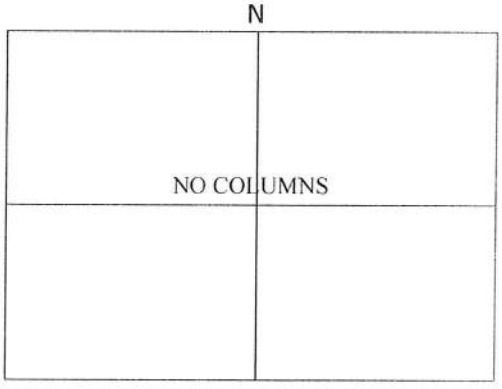
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

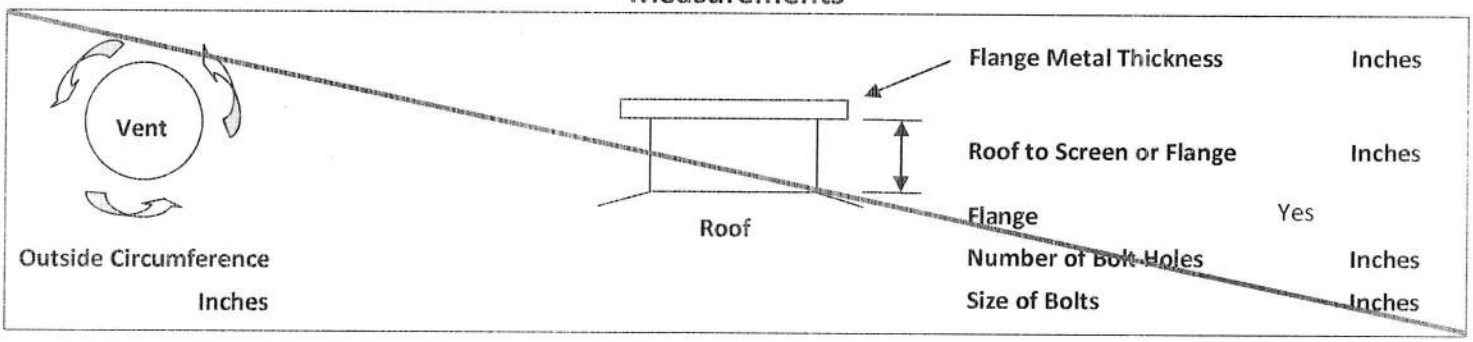
Potable Water Reservoir Security / Measurement Worksheet

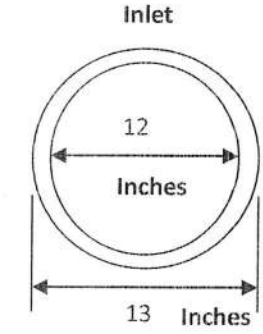
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 3A

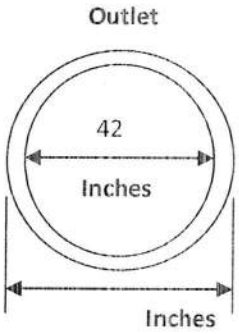
Security

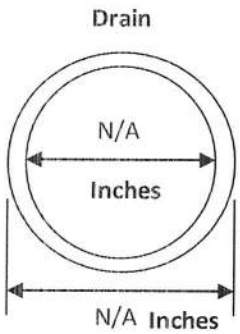
Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

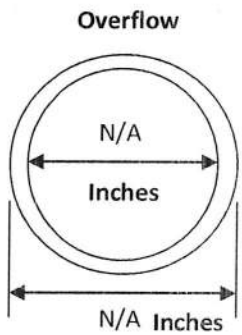
Measurements

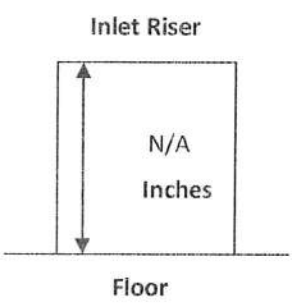


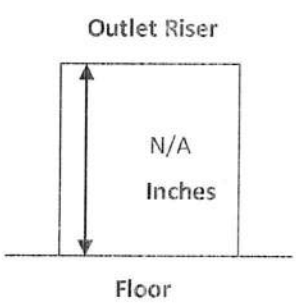


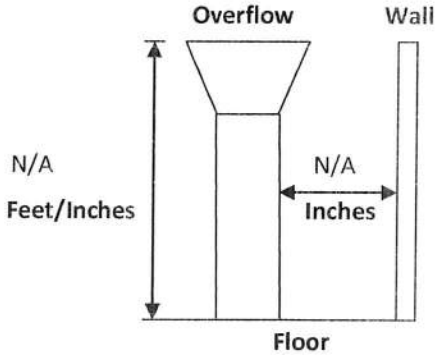












DISCLAIMER

Liquid Engineering does not provide consulting engineering services. Unless otherwise noted, the findings contained in this report were neither prepared nor reviewed by a licensed Professional Engineer, but are based on experience, training and visual examination of the Dive Maintenance Technician

Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 3A

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/15/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon reaching bottom the diver noted there was a skiff of sediment throughout the reservoir, so the diver was able to get a good look at the floor. The floor itself was found to be in good condition with only staining and adhered sediment through all quadrants. The floor to wall joint was also found to be in good condition. The lower walls have some staining, adhered sediment and bug holing but are in good condition otherwise. There are also several baffle walls in this reservoir, as shown above in the diagram. All the baffle walls have heavy efflorescence forming on the surface throughout the reservoir as well as some staining and adhered sediment but there are no other discrepancies noted. The upper walls have some staining and bug holing but are in good condition. The wall to roof joint was found to be in good condition with minor staining and efflorescence formation along the joint. The roof supports and roof slabs have some staining and minor bug holing through all quadrants and minor efflorescence on the roof supports in quadrant 2. There are 2 inlets for this reservoir and they are located in quadrant 3 along the southern wall. There was no flow at the time of inspection but it was found to be heavily corroded and the the coating is delaminating on all surfaces otherwise they are unobstructed and look to be in good working order. The outlet for the reservoir is located in quadrant 2. The valve on the outlet plumbing it is unobstructed and in good condition with only minor staining and adhered sediment on the interior. There is also another inlet opening in quadrant 4 that comes in from Clearwell 1A. It has some surface level corrosion on the hardware but is in good condition. There is also an unknown piece of plumbing located along the eastern wall in quadrant 1. The diver was unsure of its purpose but looked to be in good condition with some surface level corrosion and rust nodule formations. The internal ladder has some staining on the rungs and rails as well as some corrosion on the support brackets anchoring it to the wall but is structurally sound and securely fastened to the wall. The access hatch has no discrepancies at this time and provides unobstructed access to your reservoir. Overall this reservoir is in good condition.
Liquid Engineering recommends a cleaning and inspection every 3 to 5 years.

Existing Plant Designation: Clearwell 2A

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK CLEARWELL 2 Date: 10/16/2021

Inspector: E. BOMBERGER Dive Controller: G. ROMPF Capacity: 332,150 GAL. Dimentions: 129'L X 20'W X 18'H

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R	R	R, C, E	R, C, E
~~Expansion Joint(s)~~				
Support Beam(s)	B, R, E	B, R, E	B, R	B, R
Beam Joint(s)	R	R	R	R

General Appearance: ------ Coating: N/A

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

INTERIOR RESERVOIR WALLS

Wall-Roof Joint	R	R	R	R
Wall Structure	R, B, C, E	R, B, C, E	R, B, C, E	R, B, C, E

General Appearance: Good Coating: N/A Leaking: None observed

~~INTERIOR RESERVOIR SUPPORT COLUMNS~~

Columns				
Column Capitals				
Column Bases				

General Appearance: ------ Coating: N/A

INTERIOR RESERVOIR FLOOR

Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A ~~Sump System: ------~~ Leaking: None observed

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 2

Inspector: E. BOMBERGER | Dive Controller: G. ROMPF | Date: 10/16/2021

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	8	Minor	N/A	------	N/A	------
Outlet Plumbing	N/A	------	N/A	------	N/A	------	5	Significant
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
Other Plumbing	7	Significant	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Fair | Average Blister Size NONE

Over All Structural Condition Good | Weld Condition ---- | Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4

EXTERIOR RESERVOIR ROOF

Roof Slab(s)	UNABLE TO EVALUATE →	→	→	→
Expansion Joint(s)	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ | Coating: N/A | ~~Vents: ------~~ | Level Indicator: ------

~~All expansion Joints~~ ~~Uniform width: ------~~ | ~~Uniform Level: ------~~ | ~~Gaskets Intact: ------~~

EXTERIOR RESERVOIR WALLS

Wall-Roof Joint	UNABLE TO EVALUATE →	→	→	→
Wall Structure	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: None observed

~~Overflow Structure: ------~~

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

Perimeter Joint	UNABLE TO EVALUATE →	→	→	→
Footing Ring	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: None observed | Ground Subsidence: None observed

All expansion Joints | Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 2

Inspector: E. BOMBERGER | Dive Controller: G. ROMPF | Date: 10/16/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#: N/A	Properly Sealed: ----	
~~Water Level Indicator~~	Type: ----	Condition: ----	Penetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Other	Size: 55 X 48	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 3	in. (min 4")	Lid Height: 2	in (min 2")	Properly Secured: Yes	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: -------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

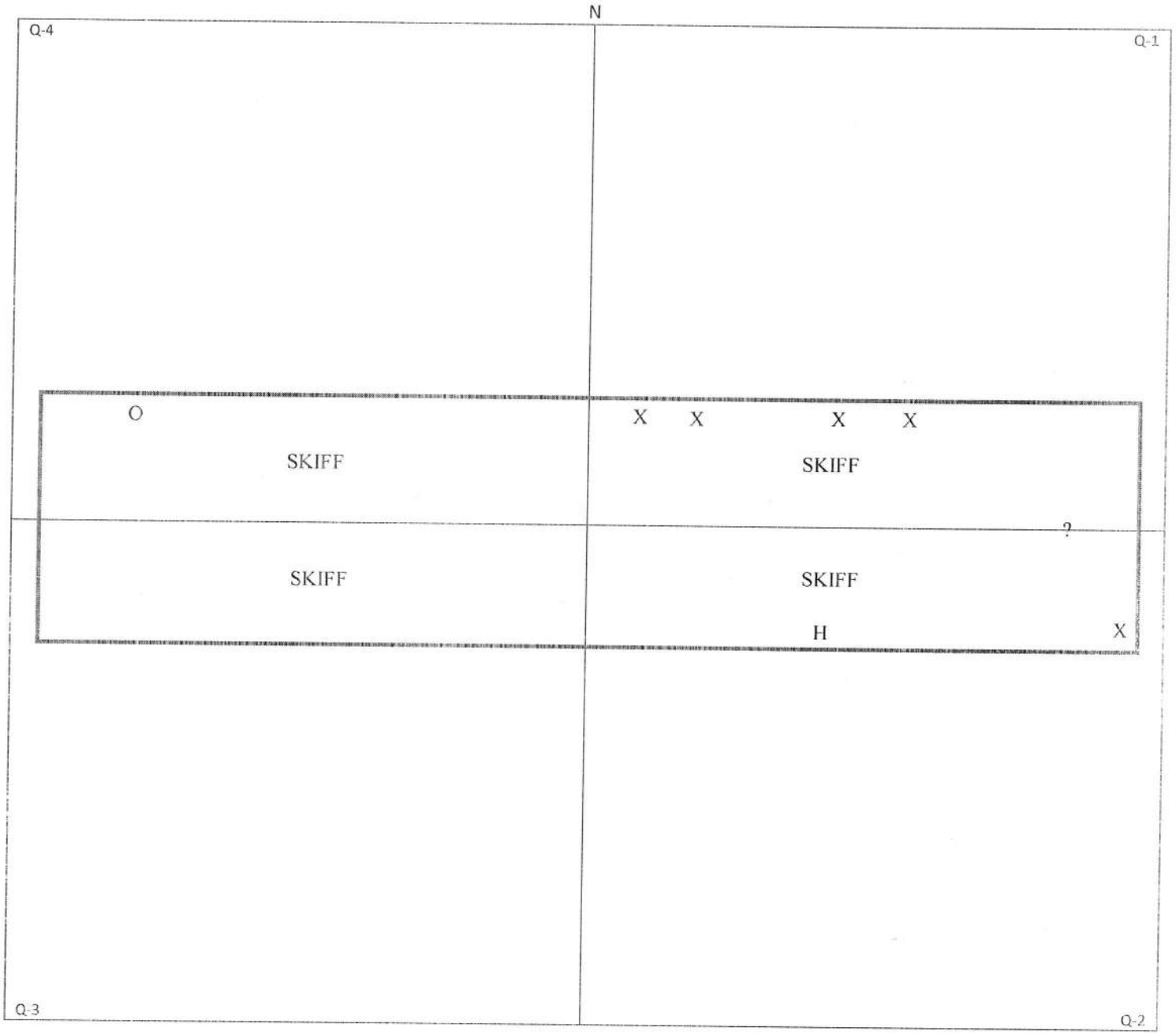
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: ----	Cracking: ----	Standing Water: ----	Other: UNABLE TO EVALUATE				
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE				
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----				
~~Antennas~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg:	Other:	
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE				
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----				
Grounding System	Present: No							

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 2



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth SKIFF **Cubic Yardage** **Sediment Type** IRON

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

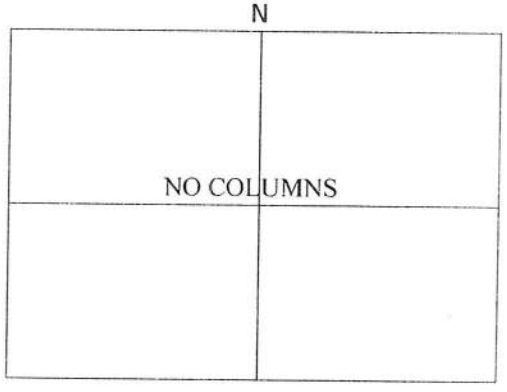
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

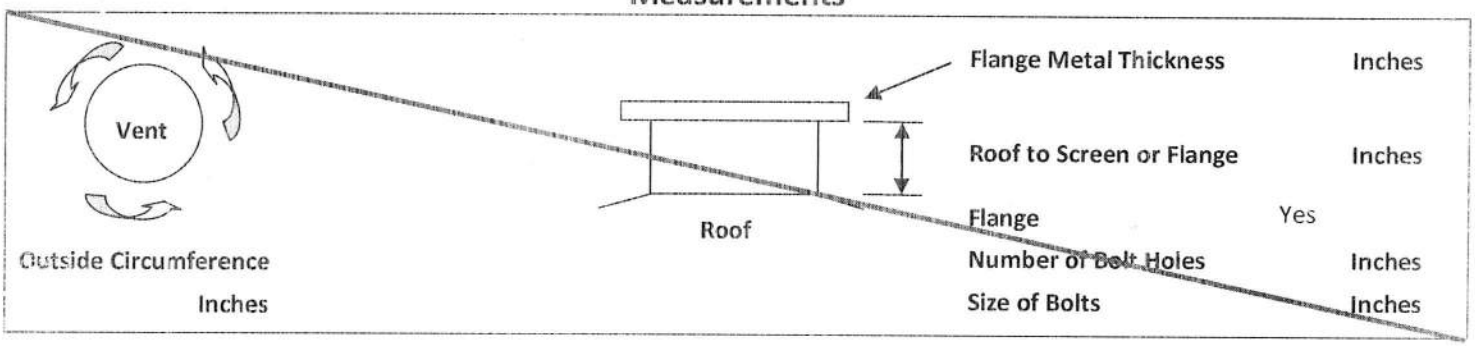
Potable Water Reservoir Security / Measurement Worksheet

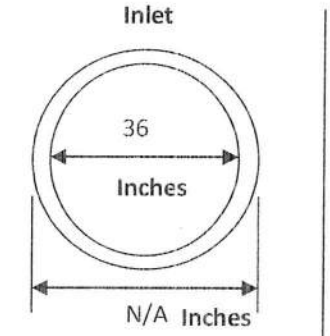
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 2

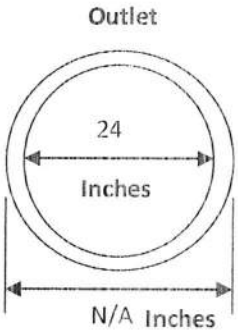
Security

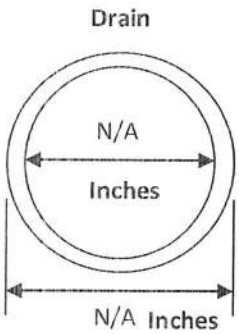
Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

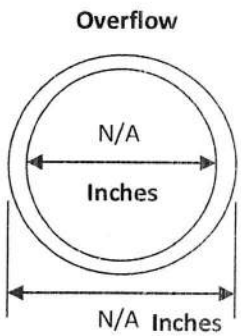
Measurements

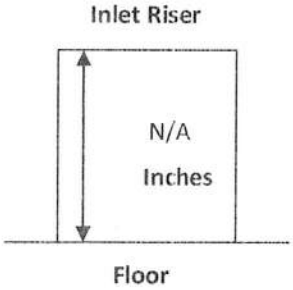


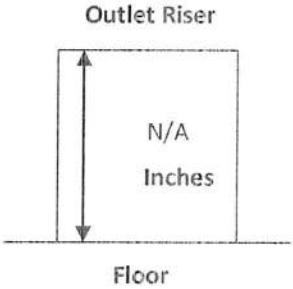


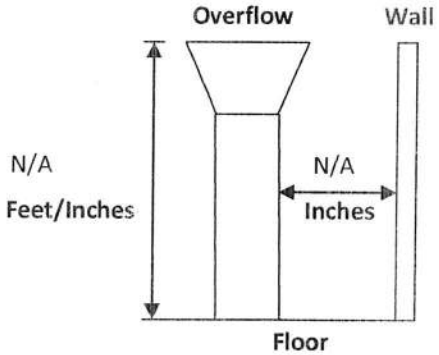












Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 2

Inspector: E. BOMBERGER | Dive Controller: G. ROMPF | Date: 10/16/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon entering the reservoir, the diver noted a "skiff" of sediment in all quadrants of the floor. The sediment appears to consist of iron, sand and filter media. Throughout all quadrants of the floor, the diver noted staining of the concrete slabs, with no other discrepancies observed. The floor to wall joint, throughout, was found to be in good condition, with only staining observed. Staining and bug holing was observed in all quadrants of the walls, as well as minor hairline cracks with efflorescence. On the upper wall of Quadrant 2, on either side of the access hatch, the diver did note a significant amount of efflorescence, which could indicate significant cracking. In the Southeast corner of the reservoir, the diver located the 36" inlet, which is connected to Clearwell 4. This inlet is free of obstruction, and exhibits only minor corrosion. Another piece of plumbing was found on the Eastern side of the reservoir, which penetrates through the roof. This piece of plumbing exhibits extensive corrosion, but does appear to be intact. Along the Northern wall, in Quadrant 1, four (4) pieces of plumbing were found penetrating the upper wall. Due to the amount of staining on the roof above these pipe, it is assumed that they act as additional inlets. In the Northwest corner of the reservoir (Quadrant 4), the diver located the outlet, which is connected to the Chlorination Chamber. This outlet is equipped with a 24" butterfly valve. Although there is a significant amount of buildup on the valve, it does appear to be unobstructed. In all quadrants of the roof, the diver noted minor hairline cracks in the concrete, which were accompanied with efflorescence. The diver also noted minor staining and bug holing on the roof slabs. All ofthe roof support beams were found to be in good condition, with only minor cracking and bug holing being observed. The primary access hatch was also found to be in good condition, and properly sealed/secured.
Liquid Engineering Corporation recommends that this reservoir be cleaned and inspected every 5 years.

Existing Plant Designation: Clearwell 2B

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK CLEARWELL 4 Date: 10/15/2021

Inspector: G. ROMPF Dive Controller: G. MOMMAERTS Capacity: 89,300 GAL. Dimentions: 20' L x 35' W

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR ROOF				
Roof Slab(s)	E, B	E, B	E, B	E, B
~~Expansion Joint(s)~~				
Support Beam(s)	E, B			E, B
Beam Joint(s)				
INTERIOR RESERVOIR WALLS				
Wall-Roof Joint	R , S	R	R	R
Wall Structure	B, R, S	B, R, S	B, R, S	B, R, S
~~INTERIOR RESERVOIR SUPPORT COLUMNS~~				
Columns				
Column Capitals				
Column Bases				
INTERIOR RESERVOIR FLOOR				
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A

~~All expansion joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

General Appearance: Good Coating: N/A Leaking: None observed

General Appearance: ------ Coating: N/A

General Appearance: Good Coating: N/A Sump System: ------ Leaking: None observed

~~All expansion joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 4

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/15/2021

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	3	Significant	N/A	------	N/A	------
Outlet Plumbing	7	Significant	N/A	------	7	Significant	N/A	------
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
Other Plumbing	N/A	------	N/A	------	N/A	------	5	Significant

Coating Deficiencies: ☑ Blistering ☑ Delamination ☐ Chalking ☑ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Fair | Average Blister Size 1/16"

Over All Structural Condition Good | Weld Condition Good | Average Pit Depth

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	UNABLE TO EVALUATE	→	→	→
Expansion Joint(s)	UNABLE TO EVALUATE	→	→	→

General Appearance: ------ | Coating: N/A | Vents: ------ | Level Indicator: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	UNABLE TO EVALUATE	→	→	→
Wall Structure	UNABLE TO EVALUATE	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: ------

Overflow Structure: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	UNABLE TO EVALUATE	→	→	→
Footing Ring	UNABLE TO EVALUATE	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

All expansion Joints | Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 4

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/15/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#:	Properly Sealed: ----	
Water Level Indicatior	Type: Electronic	Condition: Good	Pennetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Square	Size: 42" x 36"	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 8.75"	in. (min 4")	Lid Height: 3"	in (min 2")	Properly Secured: Yes	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: -------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

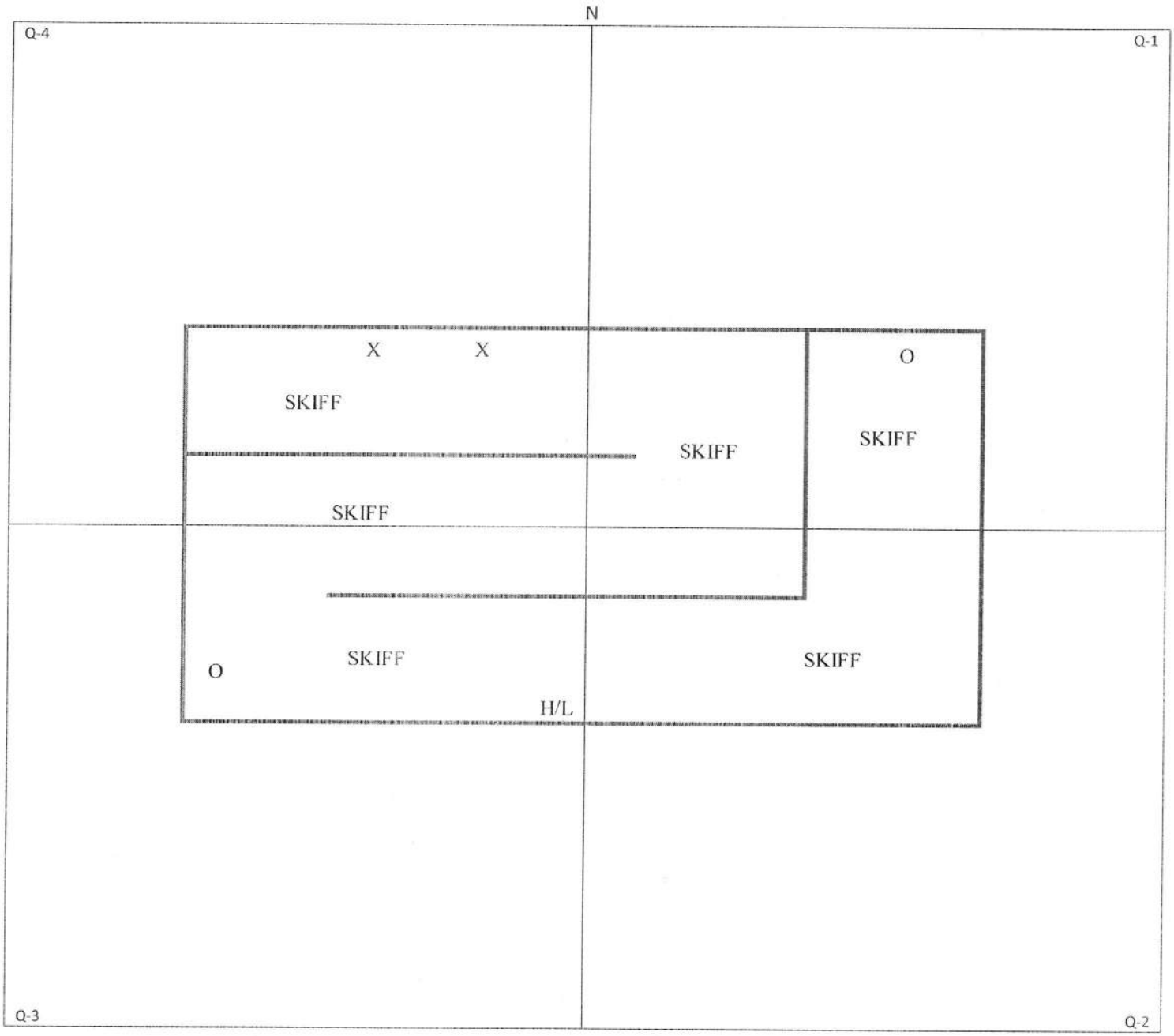
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: ----	Cracking: ----	Standing Water: ----	Other: UNABLE TO EVALUATE		
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE		
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----		
~~Antennas~~	Type: ----		#: Location(s): Roof:	Bowl:	Leg:	Other:
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE		
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----		
Grounding System	Present: No					

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 4



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth SKIFF **Cubic Yardage** **Sediment Type** IRON

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

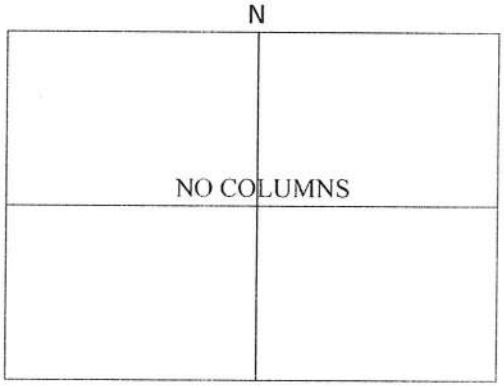
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

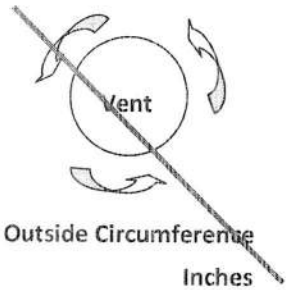
Potable Water Reservoir Security / Measurement Worksheet

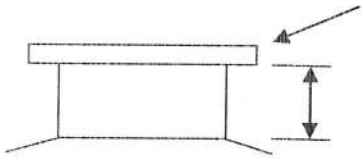
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 4

Security

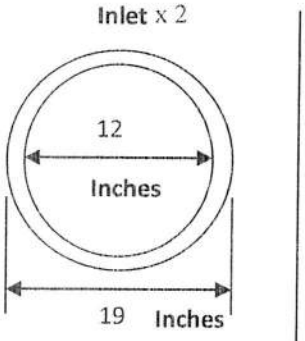
Is the area surrounding the tank well lit?	No
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

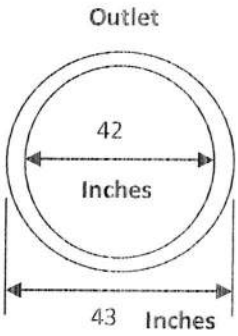
Measurements

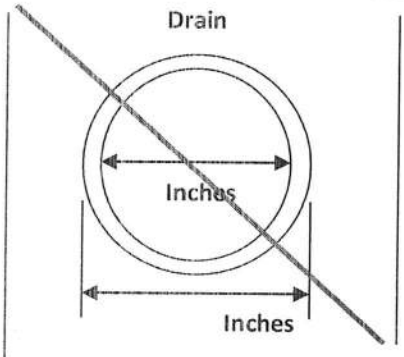


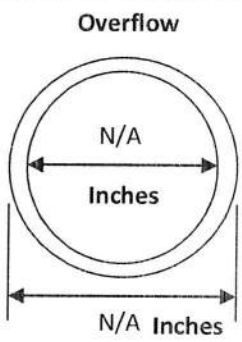


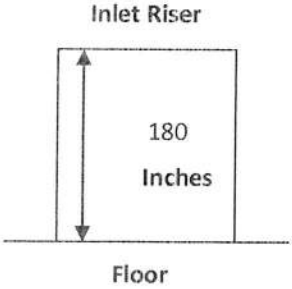
Flange Metal Thickness	N/A	Inches
Roof to Screen or Flange	N/A	Inches
Flange	N/A	
Number of Bolt Holes	N/A	Inches
Size of Bolts	N/A	Inches

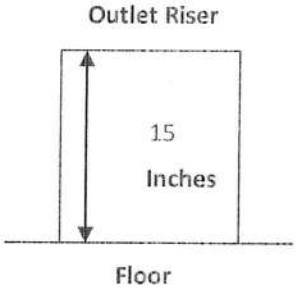


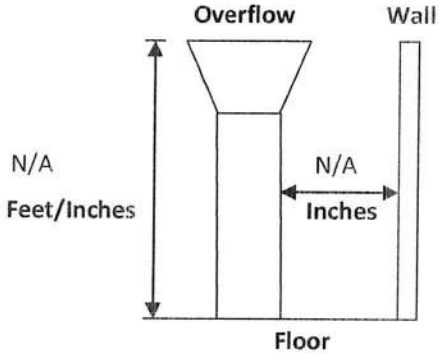












Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 4

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/15/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon entering the reservoir, the diver noted there to be a skiff of an iron-based sediment resting on the floor of the reservoir. This sediment was most heavily concentrated in the northern half of the reservoir. The floor slabs were in good condition in every quadrant, as were the perimeter joints. The east, west, north, and south walls exhibited bug holes and staining. All of the baffle walls had a build-up of a mineral deposit and smaller instances of spalling on the upper edges. The wall to roof joint had a minor instance of spalling in the first quadrant with the joint in all other quadrants being in good condition. Their was a large support beam running west to east in the first and fourth quadrants. The support beam had a build-up of efflorescence as well as many bug holes of varying sizes. The roof slabs also had many bug holes and a build up of efflorescence, occasionally heavily enough to form stalactites. The internal ladder had sediment adhered to the rails and rungs, and minor amounts of corrosion forming on the brackets and hardware connecting it to the wall. The hatch provided unobstructed access to the reservoir. Beneath the hatch were two openings covered with screens, which were in good condition. The two inlets had checking, small blisters (averaging 1/16" in diameter), and delamination of the coating, while much of the bare metal had corrosion forming. The inlets appeared to be free from obstruction. The outlets had significant amounts of corrosion forming on the flanges and associated hardware, while also being free from obstruction. Overall, the reservoir was in good condition.

Liquid Engineering Corp. recommends a clean / inspect every three years.

Existing Plant Designation: Clearwell 3A

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK CLEARWELL 1B Date: 10/14/2021

Inspector: G. ROMPF Dive Controller: G. MOMMAERTS Capacity: 117.5KG Dimentions: 81' LONG, 18' WIDE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R, C, E	R, C, E	R, C, E	R, C, E
~~Expansion Joint(s)~~				
Support Beam(s)	C, E	C, E	C, E	C, E
Beam Joint(s)				

General Appearance: Good Coating: N/A

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

INTERIOR RESERVOIR WALLS

Wall-Roof Joint	C, E, R	C, E, R	C, E, R	C, E, R
Wall Structure	R, B, C, D, E	R, B, C, D, E	R, B, C, D, E	R, B, C, D, E

General Appearance: Good Coating: N/A Leaking: None observed

INTERIOR RESERVOIR SUPPORT COLUMNS

Columns				C, R, B, D
Column Capitals				C, R, B, D
Column Bases				C, R, B, D

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

Perimeter Joint	UNABLE TO EVALUATE			
Floor Slabs	UNABLE TO EVALUATE			

General Appearance: ------ Coating: N/A Sump System: ------ Leaking: ------

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 1E

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/14/2021

SSPC Rating	
Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating	
Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating	
Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
ABLE TO ALUATE Inlet Plumbing	N/A	------	N/A	------	N/A	------	N/A	------
Outlet Plumbing	N/A	------	N/A	------	N/A	------	N/A	------
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
ABLE TO ALUATE Interior Overflow	N/A	------	N/A	------	N/A	------	N/A	------
Other Plumbing	N/A	------	3	Significant	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☐ Staining ☐ Sags/Runs

Over All Coating Condition ---- Average Blister Size N/A

Over All Structural Condition Good Weld Condition ---- Average Pit Depth N/A

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4

EXTERIOR RESERVOIR ROOF

Roof Slab(s)	UNABLE TO EVALUATE →			
Expansion Joint(s)	→			

General Appearance: ------ Coating: N/A Vents: ------ Level Indicator: ------

All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

Wall-Roof Joint	UNABLE TO EVALUATE →			
Wall Structure	→			

General Appearance: ------ Coating: N/A Leaking: ------

Overflow Structure: ------

All expar.sion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

Perimeter Joint	UNABLE TO EVALUATE →			
Footing Ring	→			

General Appearance: ------ Coating: N/A Leaking: ------ Ground Subsidence: ------

All expansion Joints Uniform Width: ------ Uniform Level: ------ Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 1B

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/14/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
~~Cathodic Protection~~	System Installed: ----	Cathodic Access Covers	#:	Properly Sealed: ----	
Water Level Indicatior	Type: ----	Condition: ----	Pennetration Points	Properly Sealed: ----	
~~Heater System~~	Installed: ----	Type: ------			
1st Access Hatch	Type: Square	Size: 37"x30"	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 14"	in. (min 4")	Lid Height: 3"	in (min 2")	Properly Secured: No	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: --------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

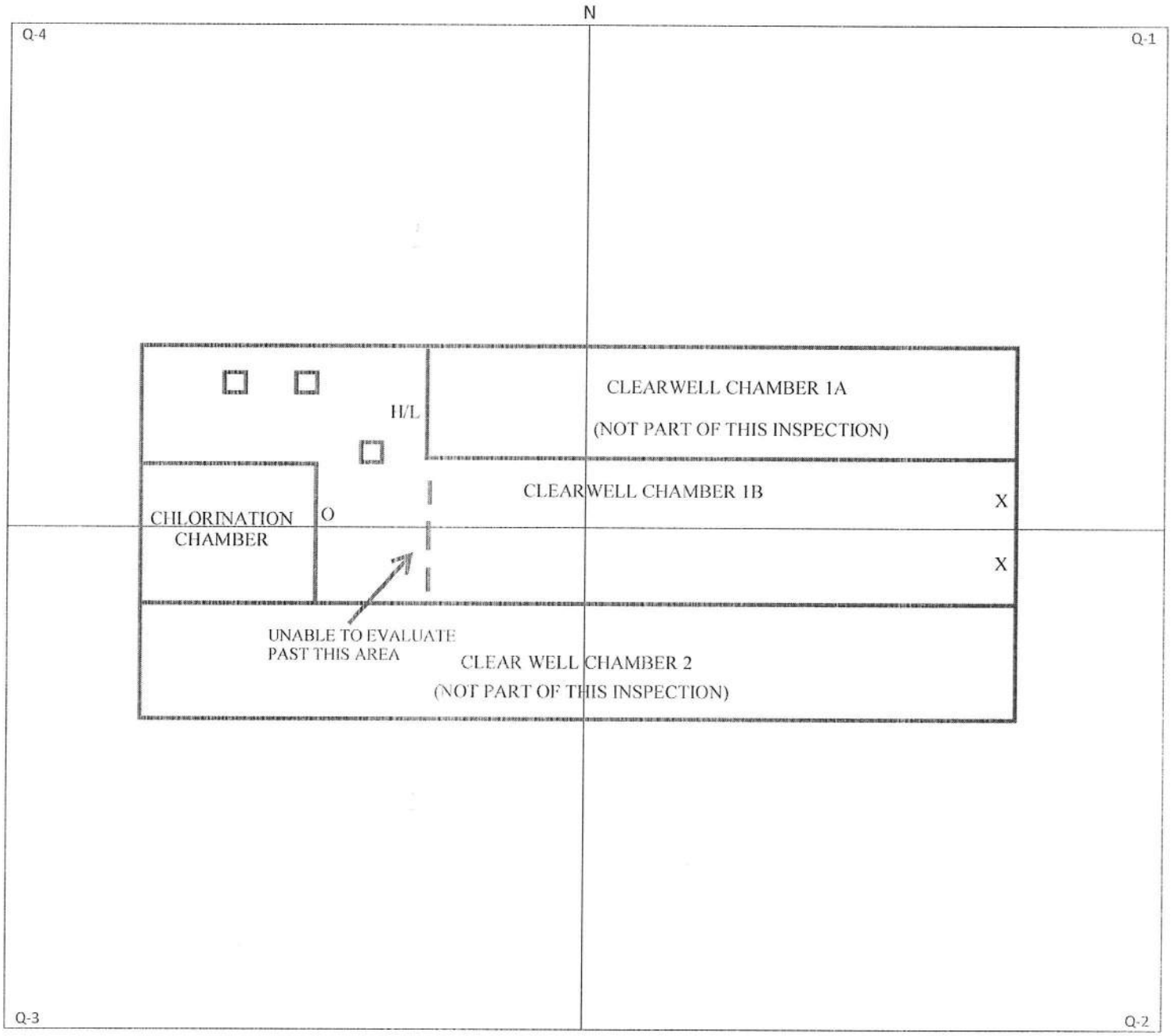
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

~~Roof Integrity~~	Holes: ----	Cracking: ----	Standing Water: ----	Other:		
~~Wall Integrity~~	Holes: ----	Cracking: ----	Leaks: ----	Other:		
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----		
~~Antennae~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg: Other:
Water Clarity	General Appearance: GOOD		Odor: NONE	Surface Debris: NONE		
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----		
Grounding System	Present: No					

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 1B



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth 1/2" **Cubic Yardage** **Sediment Type** IRON

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

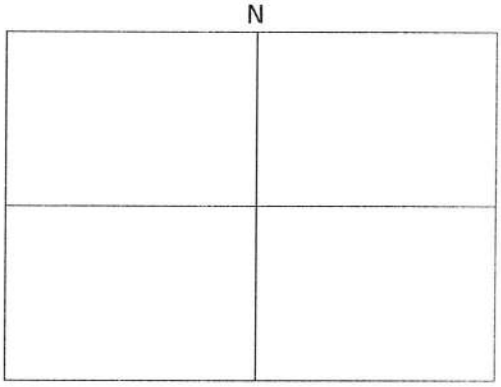
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

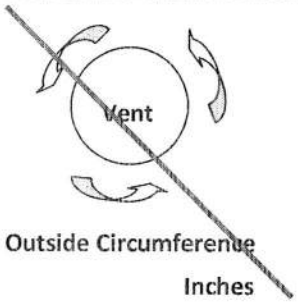
Potable Water Reservoir Security / Measurement Worksheet

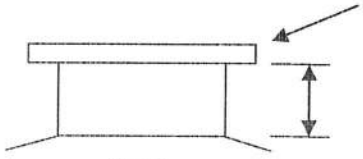
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 1B

Security

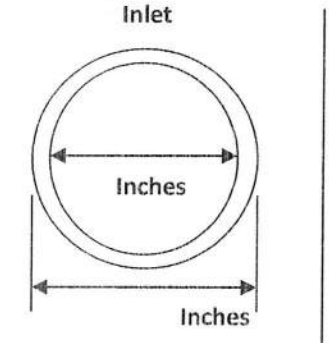
Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

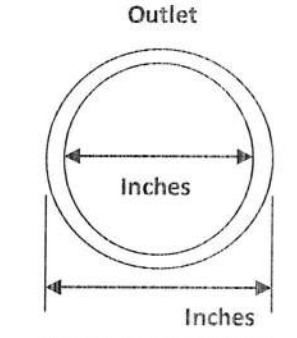
Measurements

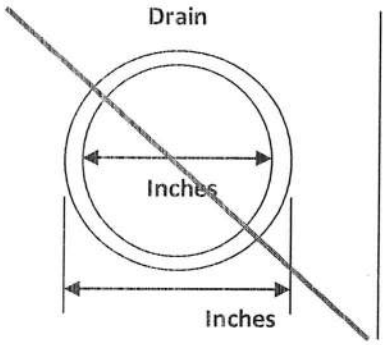


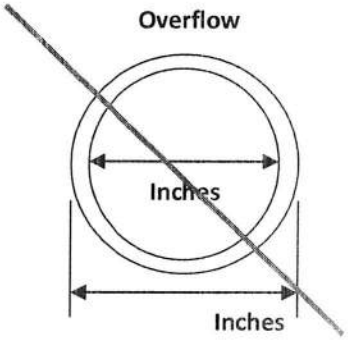


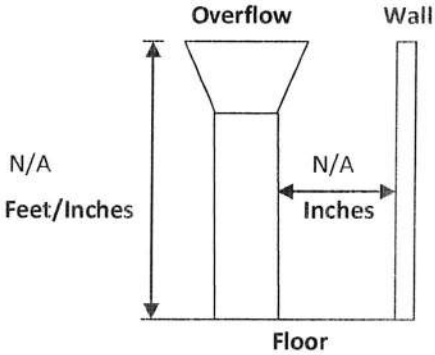
Flange Metal Thickness	N/A	Inches
Roof to Screen or Flange	N/A	Inches
Flange	N/A	
Number of Bolt Holes	N/A	Inches
Size of Bolts	N/A	Inches











Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b
Utility: CANTON WATER DEPARTMENT
Tank: SUGARCREEK CLEARWELL 1B
Inspector: G. ROMPF
Dive Controller: G. MOMMAERTS
Date: 10/14/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon entering the reservoir, the diver noted approximately 1/2 in. of an iron based sediment throughout all quadrants of the reservoir. Due to the sediment build up, the diver was unable to observe the condition of the floor slabs and floor to wall joint. A portion of the reservoir, described in the drawing above, could not be inspected as that area was entirely underwater (a "penetration dive"- requiring an additional diver). This area of the reservoir also contained the major plumbing of the reservoir. The wall structure throughout the reservoir had many bug holes (some joined so closely they resemble cracks), heavy staining, and deformation (mainly around the seams between the panel slabs) while efflorescence and shallow cracks were found above the surface. The wall-to-roof joint had deformation and minor amounts of efflorescence forming in many areas. The columns of the reservoir were heavily stained, and bug holes of varying sizes were found on the column's surfaces. The support beams of the reservoir had small bug holes, were discolored on the underside, and several wire-thin cracks were found; however, they did appear to be in good condition. The concrete roof slabs had efflorescence forming in long, thin cracks that often spanned the length of the roof. Some of this efflorescence had built up in such quantity as to form "stalactites", most notably in the north-west corner of the reservoir and near the entrance. Overall, the reservoir was in good condition.

Liquid Engineering Corporation recommends a clean/ inspect every three years.

Existing Plant Designation: Clearwell 3B

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK CLEARWELL 3B Date: 10/15/2021

Inspector: G. ROMPF Dive Controller: G. MOMMAERTS Capacity: 48,500G Dimentions: 35' L x 18' W

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR ROOF				
Roof Slab(s)	B, R, E	B, R	B, R	B, R, E
~~Expansion Joint(s)~~				
~~Support Beam(s)~~				
~~Beam Joint(s)~~				
INTERIOR RESERVOIR WALLS				
Wall-Roof Joint	R	R	R	R
Wall Structure	B, R	B, R, C	B, R	B, R
~~INTERIOR RESERVOIR SUPPORT COLUMNS~~				
Columns				
Column Capitals				
Column Bases				
INTERIOR RESERVOIR FLOOR				
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A

~~All expansion Joints: Uniform width:~~ ------ Uniform Level: ------ Gaskets Intact: ------

General Appearance: Good Coating: N/A Leaking: None observed

General Appearance: ------ Coating: N/A

General Appearance: Good Coating: N/A Sump System: ------ Leaking: None observed

~~All expansion Joints: Uniform width:~~ ~~Uniform Level:~~ ~~Gaskets Intact:~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 3E

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/15/2021

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	7	Significant	7	Significant	N/A	------	N/A	------
Outlet Plumbing	N/A	------	N/A	------	4	Significant	4	Significant
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Other Plumbing~~	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☑ Blistering ☑ Delamination ☐ Chalking ☑ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☑ Sags/Runs

Over All Coating Condition Fair | Average Blister Size 1/16"

Over All Structural Condition Fair | Weld Condition Good | Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	UNABLE TO EVALUATE	→	→	→
Expansion Joint(s)	→	→	→	→

General Appearance: ------ | Coating: N/A | Vents: ------ | Level Indicator: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	UNABLE TO EVALUATE	→	→	→
Wall Structure	→	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: ------

Overflow Structure: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	UNABLE TO EVALUATE	→	→	→
Footing Ring	→	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

All expansion Joints | Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 3B

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/15/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#:	Properly Sealed: ----	
Water Level Indicatior	Type: Electronic	Condition: Good	Pennetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Square	Size: 30" x 36"	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 9"	in. (min 4")	Lid Height: 3"	in (min 2")	Properly Secured: No	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: -------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

Primary Exterior Ladder

Location	Wall: 1	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: Good	Height: 4'	Offset Landing: No			
Vandal Guard	Present: No	Locked: ----				
Ladder Rails & Rungs	Condition: Good	Anti-Skid Rungs: No	Missing/Damaged Rungs: No			
Rung Spacing & Depth	Spacing: 11"	in. (max 12")	Toe Depth: 7.5"	in. (min 7")		
Rail Spacing & Size	Width: 2.5"	in. (min 2")	Thickness: 3/8"	in. (min 1/4")	Rail to Rail: 18"	in. (min 16")
Safety Climb System	Type: None	Condition: ----				

~~Primary Balcony & Railing~~

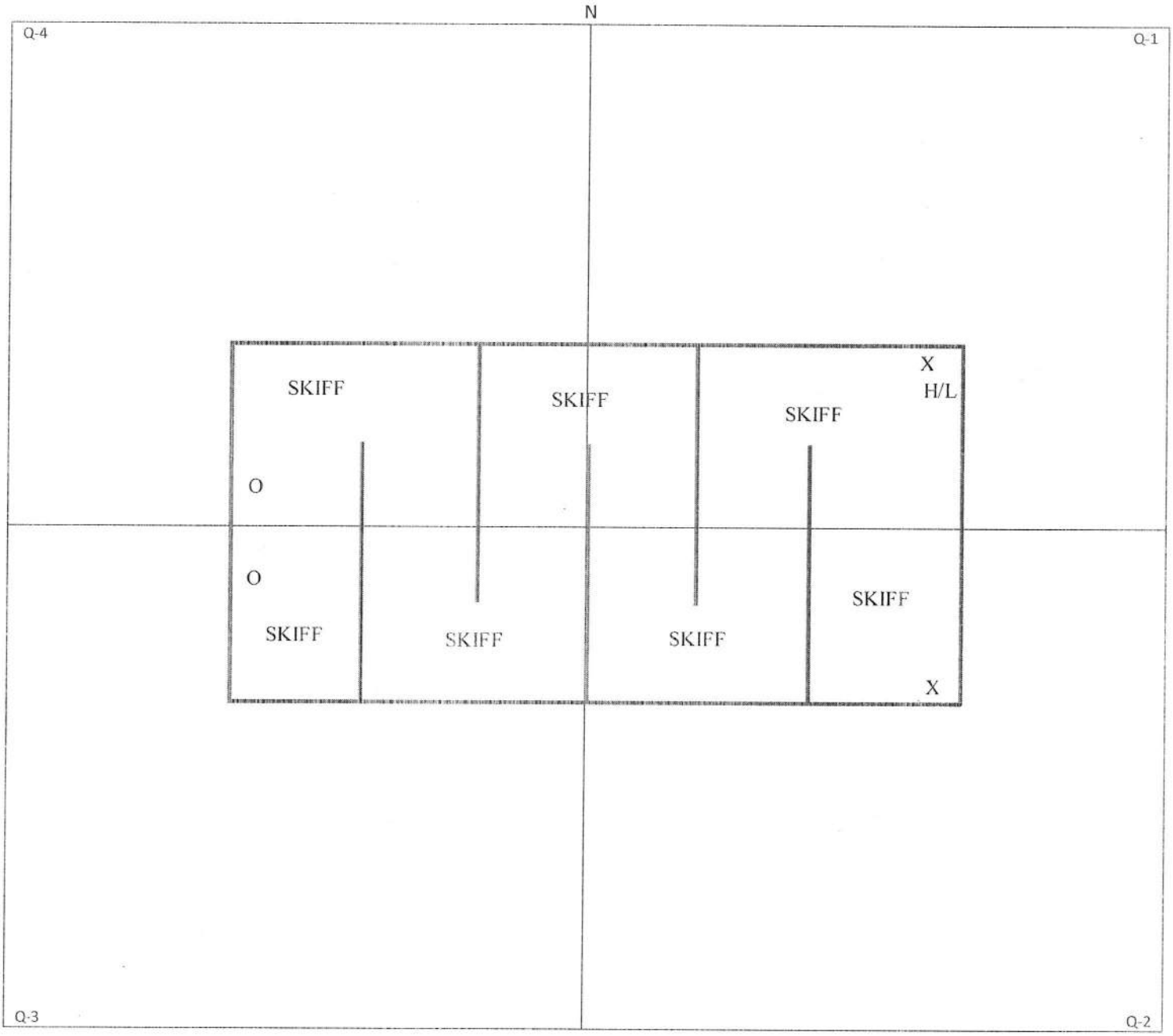
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: ----	Cracking: ----	Standing Water: ----	Other: UNABLE TO EVALUATE		
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE		
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----		
~~Antennas~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg: Other:
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE		
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----		
Grounding System	Present: No					

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 3B



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth SKIFF **Cubic Yardage** **Sediment Type** IRON

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

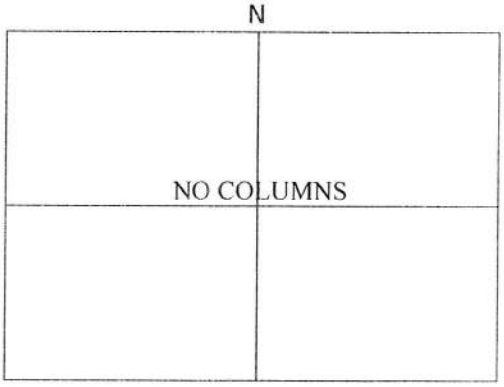
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

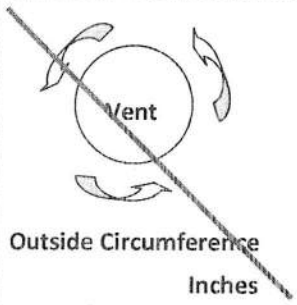
Potable Water Reservoir Security / Measurement Worksheet

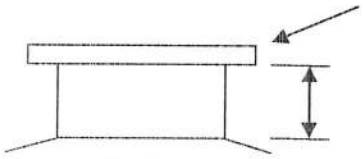
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK CLEARWELL 3B

Security

Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	No
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

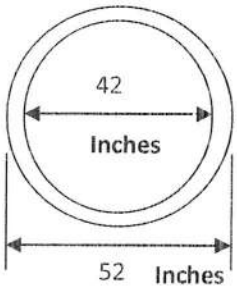
Measurements



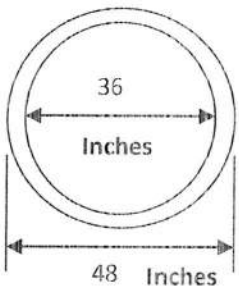


Flange Metal Thickness	N/A	Inches
Roof to Screen or Flange	N/A	Inches
Flange	N/A	
Number of Bolt Holes	N/A	Inches
Size of Bolts	N/A	Inches

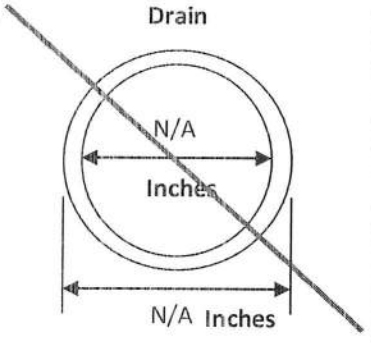
Inlet X 2



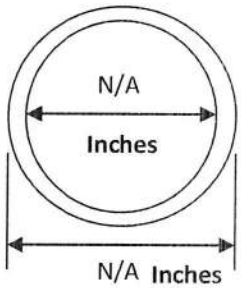
Outlet X 2



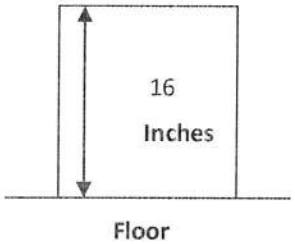
Drain



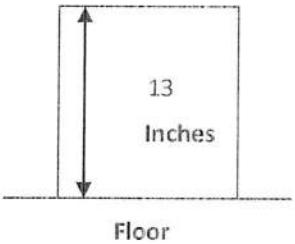
Overflow



Inlet Riser

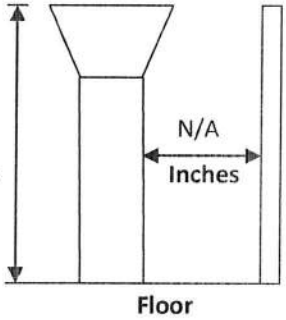


Outlet Riser



Overflow Wall

N/A
Feet/Inches



Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK CLEARWELL 3B

Inspector: G. ROMPF | Dive Controller: G. MOMMAERTS | Date: 10/15/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon entering the reservoir, the diver noted a skiff of an iron-based sediment resting on the floor, with chunks of corrosion flakes in several areas, most notably near the inlets. The floor panels were in good condition throughout the reservoir, as was the perimeter joint. The walls had bug holes of varying shapes and sizes in all sections of the reservoir, and a thin crack was located on the northern wall in the second quadrant. The baffle walls had heavy build-up of mineral deposits, especially the faces facing the south. The wall to roof joints were all in good condition. The roof slabs had bug holes forming throughout as well as efflorescence forming near the center of the reservoir. The internal ladder had adhered sediment on the rails and rungs, and minor amounts of corrosion located on the support brackets and associated hardware. The hatch allowed unobstructed access to the reservoir. There was a section of spalling on the concrete structure just beneath the hatch as well as two instances of exposed reinforcement. There were two outlets, one in the second quadrant and another in the third. Both exhibited significant amounts of corrosion on the flanges and associated hardware and small amounts on the inside seams, but did appear to be free from obstruction. The inlets were located in the northern section of the reservoir, one in the first quadrant and another in the fourth. There were significant amounts of corrosion forming on the flanges, and smaller amounts forming on the valves; however, both were free from obstruction. Overall, the reservoir was in good condition.

Liquid Engineering Corp. recommends a clean / inspect every three years.

Existing Plant Designation: High Service Pump Chamber 1

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK PUMP 2 Date: 10/14/2021

Inspector: G. MOMMAERTS Dive Controller: E. BOMBERGER Capacity: 114KG Dimentions: 27' L 26' H

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR ROOF				
Roof Slab(s)	R, B, C, E	R, B, C, E	R, B, C, E	R, B, C, E
~~Expansion Joint(s)~~				
Support Beam(s)	R, B, C	R, B, C	R, B, C	R, B, C
Beam Joint(s)	R	R	R	R

General Appearance: Good Coating: N/A

~~All expansion Joints: Uniform width:~~ ------ ~~Uniform Level:~~ ------ ~~Gaskets Intact:~~ ------

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR WALLS				
Wall-Roof Joint	R	R	R	R
Wall Structure	R, B	R, B	R, B	R, B

General Appearance: Good Coating: N/A Leaking: None observed

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
~~INTERIOR RESERVOIR SUPPORT COLUMNS~~				
Columns				
Column Capitals				
Column Bases				

General Appearance: ------ Coating: N/A

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR FLOOR				
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A ~~Sump System:~~ ------ Leaking: None observed

~~All expansion Joints: Uniform width:~~ ------ ~~Uniform Level:~~ ------ ~~Gaskets Intact:~~ ------

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK PUMP 2

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/14/2021

SSPC Rating	
Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating	
Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating	
Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	N/A	------	N/A	------	N/A	------
Outlet Plumbing	0	Significant	N/A	------	N/A	------	0	Significant
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Other Plumbing~~	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☑ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Poor | Average Blister Size NONE

Over All Structural Condition Fair | Weld Condition Poor | Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R	R	R	R
~~Expansion Joint(s)~~				

General Appearance: Good | Coating: N/A | Vents: ------ | Level Indicator: Good

~~All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

EXTERIOR RESERVOIR WALLS

Wall-Roof Joint	UNABLE TO EVALUATE →			
Wall Structure	UNABLE TO EVALUATE →			

General Appearance: ------ | Coating: N/A | Leaking: None observed

Overflow Structure: ------

All expansion Joints | Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

Perimeter Joint	UNABLE TO EVALUATE →			
Footing Ring	UNABLE TO EVALUATE →			

General Appearance: ------ | Coating: N/A | Leaking: None observed | Ground Subsidence: None observed

All expansion Joints | Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK PUMP 2

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/14/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#: N/A	Properly Sealed: ----	
Water Level Indicatior	Type: Electronic	Condition: Good	Pennetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Round	Size: 24	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 0	in. (min 4")	Lid Height: 2	in (min 2")	Properly Secured: Yes	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size:	in (24" - 18"x22")		
Support Structure	Type: --------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Overall Ladder	Condition: ----	Height:	Offset Landing: ----		
Vandal Guard	Present: ----	Locked: ----			
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----		
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")	
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail: in. (min 16")
Safety Climb System	Type: ------	Condition: ----			

~~Primary Balcony & Railing~~

Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: No	Standing Water: No	Other:
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE
~~Safety Tie-Off Points~~	Type: ----		#:	Condition: ----
~~Antenna~~	Type: ----		#: Location(s): Roof:	Bowl: Leg: Other:
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----
Grounding System	Present: No			

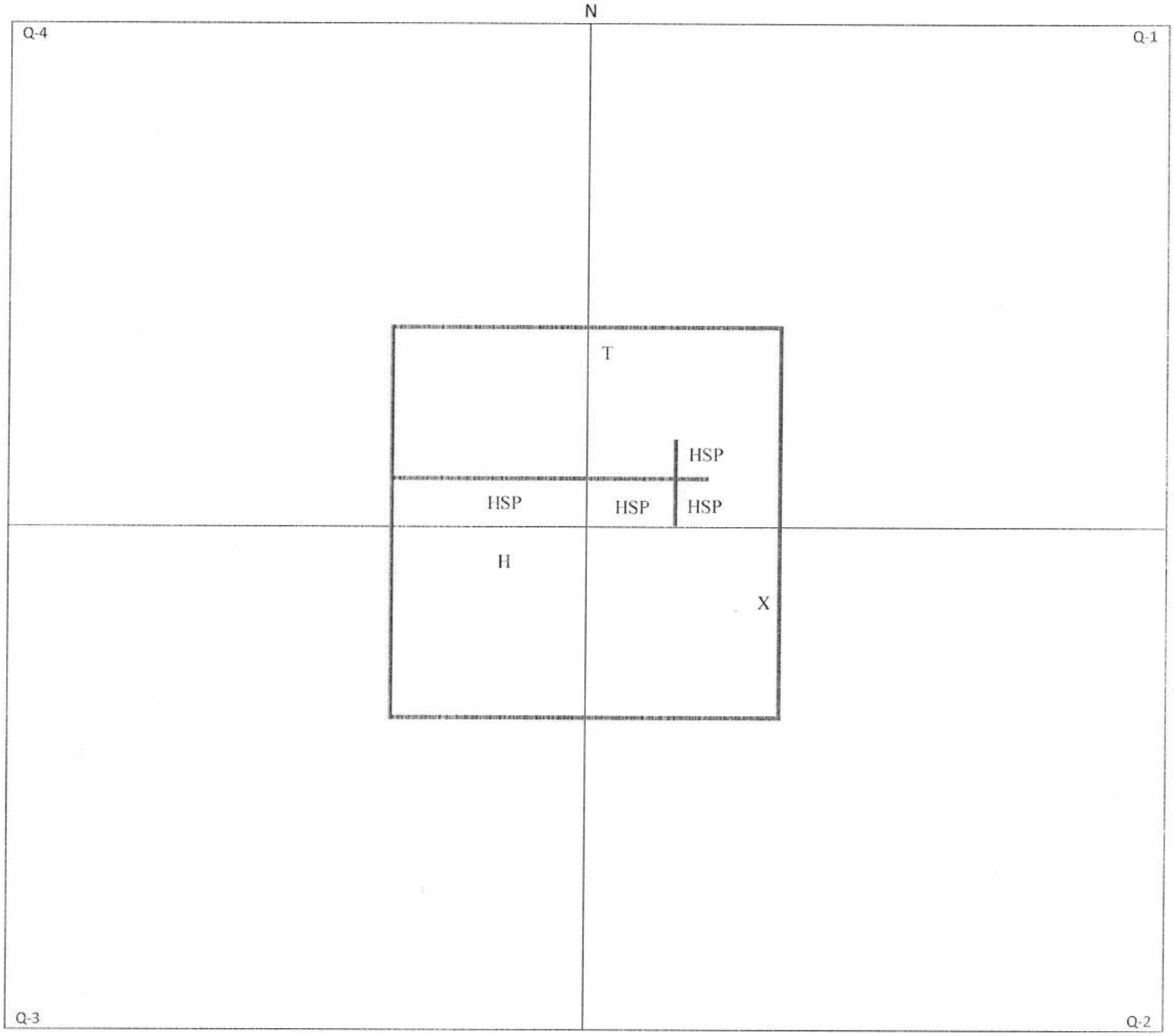
DISCLAIMER

Unless otherwise noted, the findings contained in this report were neither prepared nor reviewed by a licensed Professional Engineer, but are based on experience, training and visual examination of the Dive Maintenance Technician

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK PUMP 2



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth **Cubic Yardage** **Sediment Type**

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

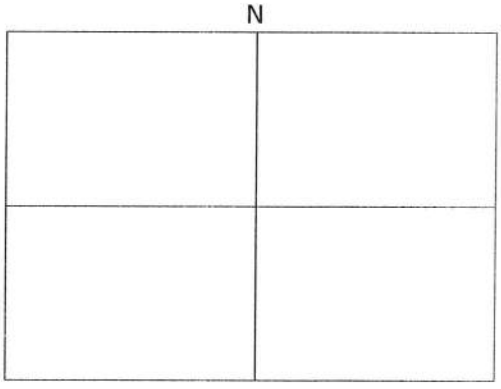
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

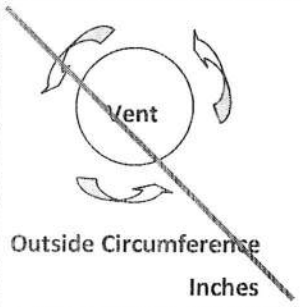
Potable Water Reservoir Security / Measurement Worksheet

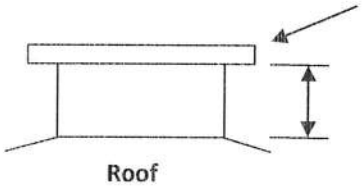
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK PUMP 2

Security

Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

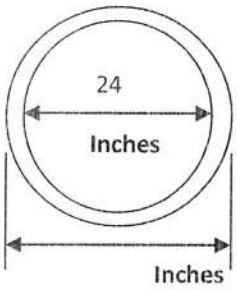
Measurements



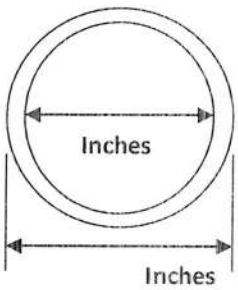


Flange Metal Thickness	N/A	Inches
Roof to Screen or Flange	N/A	Inches
Flange	N/A	
Number of Bolt Holes	N/A	Inches
Size of Bolts	N/A	Inches

Inlet

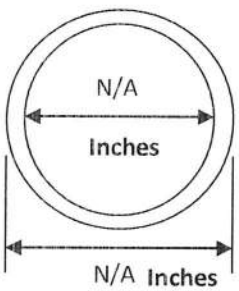


Outlet (HSPs)

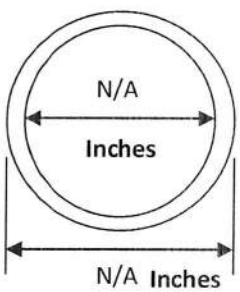


UNABLE TO OBTAIN MEASUREMENTS

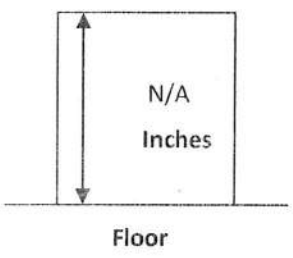
Drain



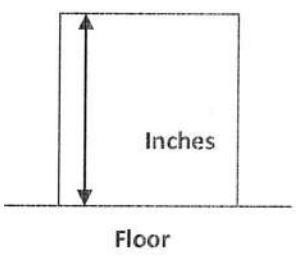
Overflow



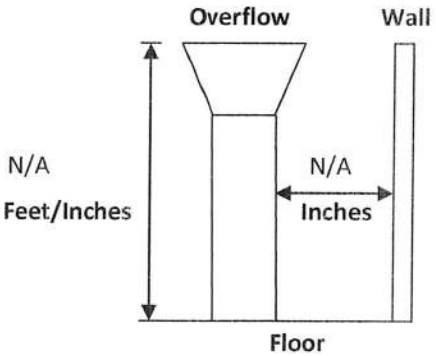
Inlet Riser



Outlet Riser



Overflow **Wall**



Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK PUMP 2

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/14/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon reaching bottom the diver noted there was no sediment so the diver was able to get a good look at the floor. There was some debris from the steel corrosion that has flaked off the plumbing and settled on the floor but the floor itself was found to be in good condition with only staining and adhered sediment through all quadrants. The floor to wall joint was also found to be in good condition with no discrepancies noted. The lower walls have some staining, adhered sediment, bug holing and minor concrete pop-outs throughout the reservoir but are in good condition otherwise. In quadrant 2 there is an opening with a valve that leads to the inlet contact chamber. There was no flow at the time of inspection and has some small rust nodules forming on the steel valve but it was found to be unobstructed and in good condition. The upper walls have some staining and bug holing but are in good condition. The wall to roof joint was found to be in good condition. The roof supports and roof slabs have some minor bug holing, minor cracking and efflorescence through all four quadrants. There is a 6 ft. baffle wall that runs down the center of the reservoir but stops about 6 ft. from the eastern wall and has some staining, bug holing and adhered sediment. There are 4 high service pumps along the baffle wall. All the pumps are intact, 2 of the pumps also have baskets securely attached to them. They appear to be inn good condition and look to be unobstructed but do have significant corrosion on all surfaces. Some of the corrosion has gotten so severe the steel has started to flake off. There is telemetry that comes into the reservoir and was found to be intact and in good working order. The access hatch has some corrosion on the interior and minor spalling of the concrete but provides unobstructed access to your reservoir. Overall this reservoir is in good condition.
Liquid Engineering recommends another cleaning and inspection every 3 to 5 years.

Existing Plant Designation: High Service Pump Chamber 2

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b Utility: CANTON WATER DEPARTMENT Tank: SUGARCREEK PUMP 1 Date: 10/14/2021

Inspector: G. MOMMAERTS Dive Controller: E. BOMBERGER Capacity: 134KG Dimentions: 30' L X 26' W

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
INTERIOR RESERVOIR ROOF				
Roof Slab(s)	R, B, C, E	R, B, C, E	R, B, C, E	R, B, C, E
~~Expansion Joint(s)~~				
Support Beam(s)	R, C	R, C	R, C	R, C
Beam Joint(s)	R	R	R	R

General Appearance: Good Coating: N/A

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

INTERIOR RESERVOIR WALLS				
Wall-Roof Joint	R	R	R	R
Wall Structure	R, B	R, B	R, B	R, B

General Appearance: Good Coating: N/A Leaking: None observed

~~**INTERIOR RESERVOIR SUPPORT COLUMNS**~~				
Columns				
Column Capitals				
Column Bases				

General Appearance: ------ Coating: N/A

INTERIOR RESERVOIR FLOOR				
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A ~~Sump System: ------~~ Leaking: None observed

~~All expansion Joints: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK PUMP 1

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/14/2021

SSPC Rating	
Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating	
Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating	
Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	N/A	------	N/A	------	N/A	------
Outlet Plumbing	N/A	------	1	Significant	1	Significant	N/A	------
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Interior Overflow~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Other Plumbing~~	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☐ Blistering ☑ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Poor | Average Blister Size NONE

Over All Structural Condition Fair | Weld Condition Fair | Average Pit Depth NONE

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed	X - Exposed
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains	Aggregate	Reinforcement

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R	R	R	R
~~Expansion Joint(s)~~				

General Appearance: Good | Coating: N/A | ~~Vents: ------~~ | Level Indicator: Good

~~All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	UNABLE TO EVALUATE →	→	→	→
Wall Structure	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: None observed

Overflow Structure: ------

~~All expansion Joints Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------~~

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	UNABLE TO EVALUATE →	→	→	→
Footing Ring	UNABLE TO EVALUATE →	→	→	→

General Appearance: ------ | Coating: N/A | Leaking: None observed | Ground Subsidence: None observed

All expansion Joints | Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK PUMP 1

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/14/2021

FACILITY SAFETY & HEALTH

~~Primary Air Vent~~	Type: ----	Screen : ----	Pressure Vacuum / Frost Proof: ----		
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----	
Cathodic Protection	System Installed: No	Cathodic Access Covers	#: N/A	Properly Sealed: ----	
Water Level Indicatior	Type: Electronic	Condition: Good	Pennetration Points	Properly Sealed: ----	
Heater System	Installed: No	Type: ------			
1st Access Hatch	Type: Round	Size: 24	in. (24" - 24" x 15" min)	Properly Sealed: Yes	
Hatch Height: 0	in. (min 4")	Lid Height: 2.5	in (min 2")	Properly Secured: Yes	
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----	
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----	

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Type and Size	Type: ------	Size:	in (24" - 18"x22")			
Support Structure	Type: --------	Condition: ----				
WT Integrity	Leaks: ----	Condition: ----				

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

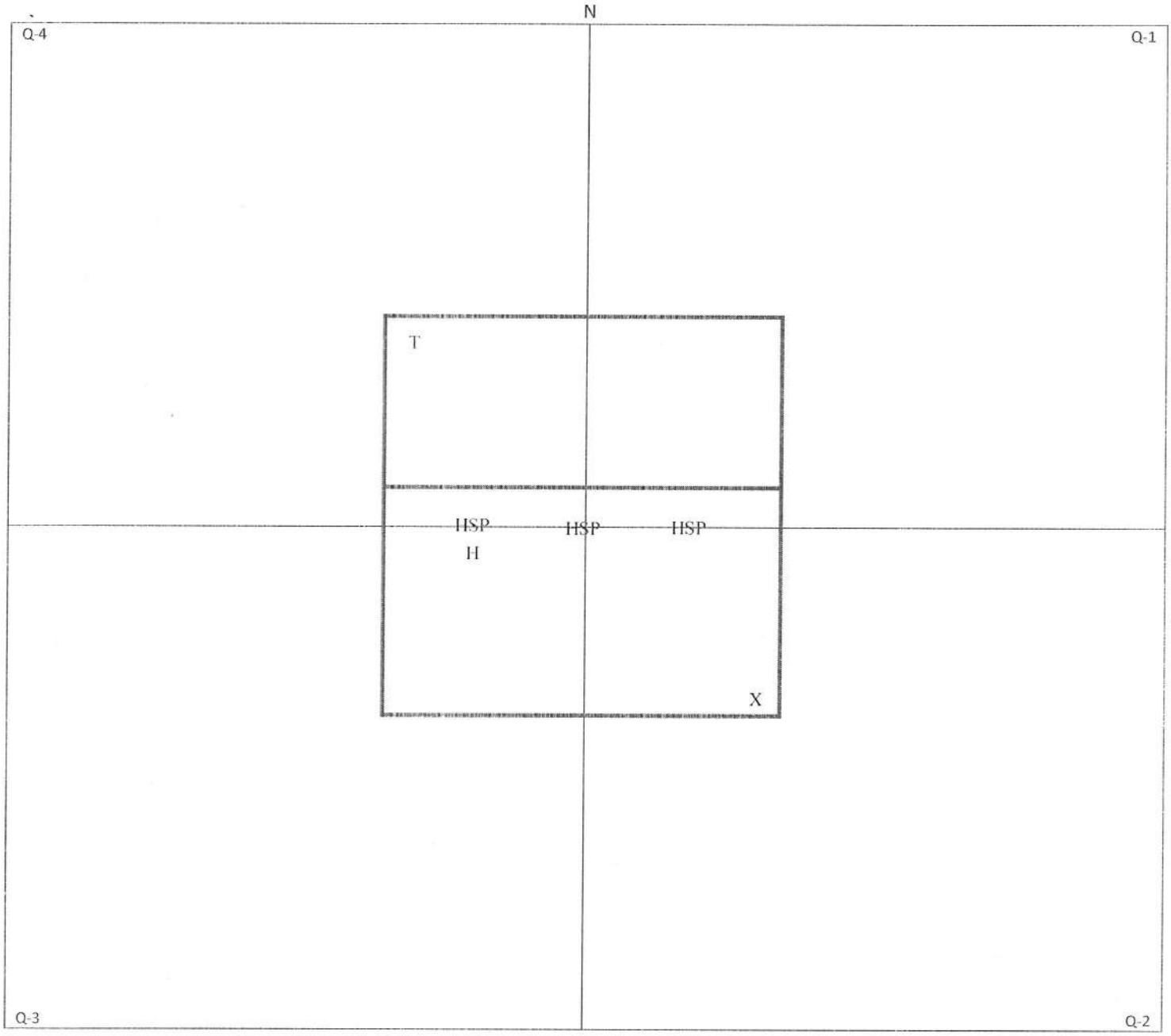
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width:	in. (min 24")	
Top Rails	Condition: ----	Height:	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height:	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height:	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: No	Standing Water: No	Other:				
Wall Integrity:	Holes: ----	Cracking: ----	Leaks: ----	Other: UNABLE TO EVALUATE				
~~Safety Tie Off Points~~	Type: ----		#:	Condition: ----				
~~Antennas~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg:	Other:	
Water Clarity	General Appearance: CLEAR		Odor: NONE	Surface Debris: NONE				
~~Hypalon Floating Cover~~	Condition: ----		Holes: ----	Tears: ----				
Grounding System	Present: No							

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK PUMP 1



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth **Cubic Yardage** **Sediment Type**

Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway

V=Vent D=Drain S=Sump

L=Ladder H=Hatch P=Overflow

F=Float Level Indicator

T=Telemetry

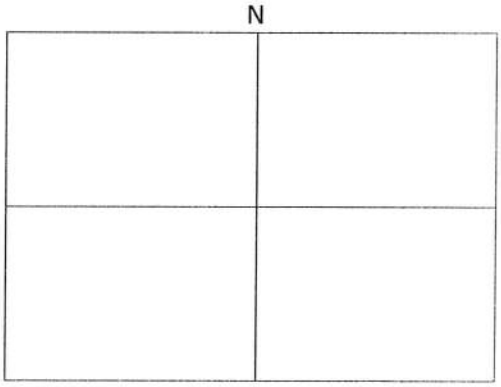
Column Placement

Type of Column

Base Structure

Top Structure

Column Construction ------



Liquid Engineering Corporation

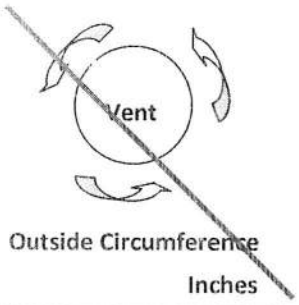
Potable Water Reservoir Security / Measurement Worksheet

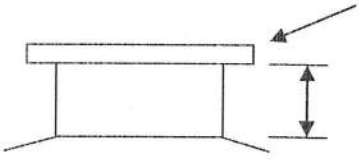
Job Number 54974b Utility Name CANTON WATER DEPARTMENT Tank Name SUGARCREEK PUMP 1

Security

Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

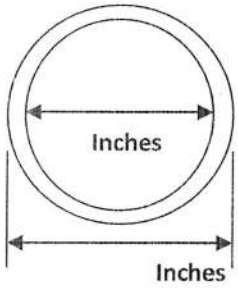
Measurements





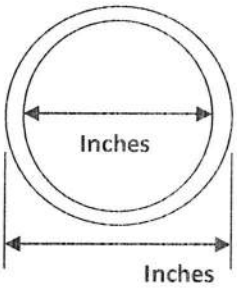
Flange Metal Thickness	N/A	Inches
Roof to Screen or Flange	N/A	Inches
Flange	N/A	
Number of Bolt Holes	N/A	Inches
Size of Bolts	N/A	Inches

Inlet



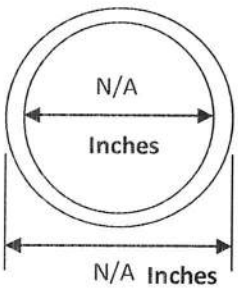
30" X 30" OPENING

Outlet (HSP)

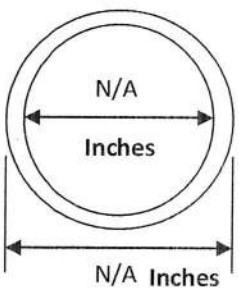


UNABLE TO OBTAIN MEASUREMENTS

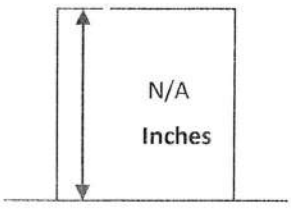
Drain



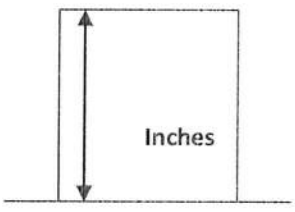
Overflow



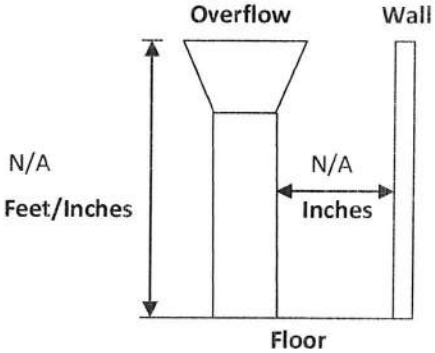
Inlet Riser



Outlet Riser



Overflow **Wall**



Liquid Engineering Corporation

Potable Water Reservoir Immediate Needs Assessment

Job Number: 54974b | Utility: CANTON WATER DEPARTMENT | Tank: SUGARCREEK PUMP 1

Inspector: G. MOMMAERTS | Dive Controller: E. BOMBERGER | Date: 10/14/2021

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Upon reaching bottom the diver noted there was no sediment so the diver was able to get a good look at the floor. There was some debris from concrete and steel corrosion that has flaked off the plumbing and settled on the floor but the floor itself was found to be in good condition with only staining and adhered sediment throughout. The floor to wall joint was also found to be in good condition. The lower walls have some staining, adhered sediment and bug holing but are in good condition otherwise. In quadrant 2 there is an opening that leads to the inlet contact chamber. There was no flow at the time of inspection but it was found to be unobstructed and in good condition. The upper walls have some staining and bug holing but are in good condition. The wall to roof joint was found to be in good condition with no discrepancies noted at this time. The roof supports and roof slabs have some minor bug holing, minor cracking and efflorescence through all quadrants. There is a 6 ft. baffle wall that runs down the center of the reservoir and has some staining, bug holing and adhered sediment. There are 3 high service pumps along the baffle wall. All the pumps are intact and in good condition and look to be unobstructed but do have significant corrosion on all surfaces. Some of the corrosion has gotten so severe the steel has started to flake off. There is telemetry that comes into the reservoir and was found to be intact and in good working order. The access hatch has some corrosion on the interior and minor spalling of the concrete but provides unobstructed access to your reservoir. Overall this reservoir is in good condition.
Liquid Engineering recommends another cleaning and inspection every 3 to 5 years.

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APPENDIX IV - OHIO DRILLING COMPANY QUOTE

The Ohio Drilling Company

April 6th , 2022

Carl M. Seifried,PE
Senior Project Manager
Burgess & Niple

Dear Carl:

I'm writing to provide you with the quote you recently requested for the vertical turbine pump rehabilitation for the Sugar Creek Well field pumps. All work will be directly coordinated with the General Contractor. Please refer to **section 43 21 14.01/ #5 (Pump service Company shall perform the following)** in the general contract. Below is the estimated cost breakdown (per pump) for Wells 1-10:

Well Pump Work (per well)	**Cost**
Pull Motor, Discharge Head & Pump	$3,500.00
Inspect Pump & Store (safe location)	$850.00
New Baseplate Fabrication	$2,800.00
2" Pipe installation (level control insertion)	$750.00
6" Gravel Tube Installation	$2,800.00
Reinstall Motor, pump, head	$3,500.00
Assist in Start up	$500.00
Total	**$14,700.00**

Please note if any pump deficiencies are noted when the pump is removed The Ohio Drilling Company shall notify the owner and work order may be issued.

Please refer to **section 43 21 14.02 B** in the general contract for the scope of work on High Service pumps #2, #3, #4, and #5. They are corroded and shall be replaced with new units that match the same overall dimensions of the existing unit. This includes the rebuild of pumps #2, #3, #4, and #5 (Pull pump, ship, clean, inspect, rotate impellers, new bearing, RTDs, new discharge head/stand, and reinstall pump and motor). Below is the estimated cost breakdown for this work:

High Service Pump Work (per pump) #2, #3, #4, #5	Cost
Pull Motor, Discharge Head & Pump	$4,500.00
Inspect Pump & Shop Labor (Bowl Assembly tear down)	$4,950.00
New Baseplate Fabrication	$1,750.00
New Fabricated Discharge Head	$30,000.00
Bowl Assembly rebuild (bearings, rotate impellers)	$6,000.00
Impeller coating	$1,500.00
Reinstall Motor, pump, head	$5,500.00
Total	**$54,200.00**

Please note if any pump deficiencies along the 16" flanged column pipe and shaft are noted when the pump is removed The Ohio Drilling Company shall notify the owner and work order may be issued.

Motors #3, #4 & #5 Scope of work & quote

*Below is the brief description our electrical contractor has provided for the scope of work that High Service motors 3, 4 & 5 will receive.

All motor repairs start with disassembly and visual inspection. Next, we hook the stator up to our static motor analyzer which tests insulation resistance, polarization index, dielectric absorption, DC hipot/step voltage and surge test to evaluate insulation breakdown. It also tests the motor circuit utilizing resistance, impedance, capacitance, phase angle and dissipation factor/quality factor.

The motor is then washed in our parts washer (filled with Vanguard motor cleaner) and/or our di-electric solvent tank to remove all grease, dirt, & foreign material. Once clean, we test all wearable surface tolerances (shaft bearing surface, shaft seal surface, bearing housings, etc.). For worn shafts, we would weld the worn area and machine to the desired tolerance. If a worn bearing housing is found, we bore and sleeve the endbell housing. To ensure our endbell bore is truly aligned we indicate off of the alignment lip of the endbell, which aligns with the stator, ensuring a true, straight bore.

Below is estimated cost breakdown for this work on both 450 hp motors and the 500 hp:

High Service Motor Repair Quote	Cost
450 hp SER#232676	$24,930.00
450 hp SER#232677	$24,930.00
500 hp ID#H06007/Z09Z1150432-R-1	$15,933.00
Total	**$65,793.00**

Below is the cost for the New 250 Hp motor specified in the general contract.

Motor Quote	**Cost**
250 HP 480 Volt, 1200 rpm, Induction Motor	$59,777.00
Total	**$59,777.00**

WORK NOT INCLUDED:

1. The cost of rewinding a damaged motor is not included in this proposal. If all of this testing shows that the motor has been burnt up we would move on to our rewinding process, the Owner and Engineer will be notified before any repair work is completed as described above. A proposal to rewind the motor work with costs and recommended scope shall be submitted to the Owner / Engineer. The Owner and Engineer will determine whether to rewind the motor and continue with its rebuilding or consider replacement of the motor.
2. The cost of a new replacement motor is not included in this quotation. If requested, a cost proposal will be provided for a new motor to replace the damaged motor. Upon receipt of the quotation for the replacement motor, and the Owner and Engineer will review the proposal and determine how to proceed.
3. Any salvage value that may be realized for the recycling and disposal of the damaged motor will be credited to the work performed to remove, disassemble, and inspect the motor.

If you have any questions regarding this or any other correspondence, please do not hesitate to contact me. Thank you for the opportunity to work on your water well and pump needs.

Sincerely yours,
OHIO DRILLING COMPANY

By

Alex Thomas

Geologist

Appendix E

Code of Federal Regulations

Title 45 - Public Welfare

Volume: 4
Date: 2010-10-01
Original Date: 2010-10-01
Title: Section 2543.87 - Byrd anti-lobbying amendment.
Context: Title 45 - Public Welfare. Subtitle B - Regulations Relating to Public Welfare (Continued). CHAPTER XXV - CORPORATION FOR NATIONAL AND COMMUNITY SERVICE. PART 2543 - GRANTS AND AGREEMENTS WITH INSTITUTIONS OF HIGHER EDUCATION, HOSPITALS, AND OTHER NON-PROFIT ORGANIZATIONS. Subpart E - Statutory Compliance.

§ 2543.87 Byrd anti-lobbying amendment.

Contractors who apply or bid for an award of $100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.

Appendix E

ODOT Office of Local Programs
Notice to the Industry

In December 2014, a compliance review of ODOT's Disadvantaged Business Enterprise (DBE) Program was conducted by the Federal Highway Administrations (FHWA's) Office of Civil Rights. A subsequent review was conducted in June 2015. The purpose of the reviews was to determine ODOT's compliance with the DBE program regulations found in 49 CFR Part 26.

In the end, it was determined that the ODOT DBE Program was noncompliant with Federal regulations. A total of 32 areas were identified in which the Department was deficient in implementing the Federal requirements; 7 of these were directly related to the Local Let program.

As a result of those findings, ODOT and FHWA entered into a Conciliation Agreement in September 2015 to address those areas of noncompliance in ODOT's DBE program. Since the inception of this agreement, the Office of Local Programs has played an integral part in addressing specific deficiencies related to the Local Let program and has worked to develop solutions to ensure compliance.

Following, are the programmatic and process changes that have been or will be implemented by ODOT's Office of Local Programs to address these seven areas.

PN007

This Note is a Local-let specific version of the ODOT-let PN 007 that was drafted in December of 2019. Requirements to monitor DBE Trucking have been updated to a monthly process that will be completed as part of the Trucking Affidavit Section on the new Prompt Payment Spreadsheet (*see PN31 Prompt Payment guidance below*). The Prime Contractor will be required to monitor trucking firms being used on the project and make appropriate selections on the Affidavit section of the Prompt Payment Spreadsheet.

Training and Guidance for this process can be located at:
https://www.transportation.ohio.gov/wps/portal/gov/odot/programs/local-programs/resources/prompt-pay

PN13

A Local-let specific version of PN 13 was finalized and added to the Bid Doc Template in March of 2019. This proposal note outlines the requirements for identifying DBEs pre-award who will be utilized to meet the established project goals through the Utilization and Affirmation processes. This Proposal Note also provides defining criteria for Good Faith Efforts, termination, and the replacement of DBE firms.

Good Faith Efforts, termination, and replacement guidance may be located at:
https://www.transportation.ohio.gov/wps/portal/gov/odot/programs/business-economic-opportunity/dbe/dbe-resources

For reference purposes, the Local-let Bid Doc Template may be found in the Forms/Bid Preparation Section at the following web page address:
https://www.transportation.ohio.gov/wps/portal/gov/odot/working/publications/local-let-manual

PN31

This Proposal Note was developed to outline the new comprehensive Prompt Payment and Commercially Useful Function (CUF) Procedures via the GoFormz platform. A template for this form may be found and submitted via the GoFormz website located at www.goformz.com (*see detailed directions for creating an account below*).

The Code of Federal Regulations (CFR), 49 CFR Part 26. Within 49 CFR Part 26, 49 CFR 26.29 define the prompt payment requirements that apply to ODOT (the Department), its subrecipients (LPA's), and, by extension, both Prime Contractors and Subcontractors (including non-DBEs). The Prime Contractor must comply with this Proposal Note and the Department's prompt payment requirements as published in Section 107.21 of the Construction and Materials Specifications (C&MS).

Additionally, ODOT will monitor payments made by Prime Contractors and Subcontractors for compliance with this Proposal Note, C&MS 107.21 and, where applicable, 49 CFR 26.29. To facilitate this monitoring, the Department requires prime contractors to report their payments to all subcontractors with the submission of each invoice. The payment data reported must include any retainage withheld and any previously withheld retainage released. All such reporting will take place through a web-based submission on a customized version of ODOT's GoForms, which will be directly routed to a project specific folder on a SharePoint site created by each district.

Invoices will not be approved and processed for payment unless this reporting form has been submitted and received by the Department.

To obtain a GoFormz account, you must first register and obtain a MyODOT account. To do this, please click Link and follow directions outlined on the website. Two process flowcharts linked below have also been provided to assist in better understanding this process.

https://www.transportation.ohio.gov/static/Working/data-tools/PromptPay/Visio-LPA-LocalPublicAgency-access-GoFormz-SharePoint.pdf

https://www.transportation.ohio.gov/static/Working/data-tools/PromptPay/Visio-LPA-PrimeContractoraccess-GoFormz.pdf

Once a MyODOT account has been set up, the account holder will need to email: GoFormz.Help@dot.ohio.gov

- In the Subject Line type Create GoFormz Account;
- After, a Login for Goformz will be emailed back to the sender, then
- Click www.goformz.com to access GoFormz and set up your account

You may access online training for Prompt Payment and CUF on the Local Programs LTAP page at the following web address:

http://www.dot.state.oh.us/Divisions/Planning/LocalPrograms/LTAP/Pages/Ohio_LTAP_eLearning.aspx

Additionally, a very beneficial GoFormz training/ YouTube webinar recording can be found at:

https://youtu.be/hes_7zi2n2U

PN32

To ensure compliance with State and Federal laws which require all contractors and subcontractors to be documented in writing and in conformity with all applicable laws and regulations, the Department will require that a C92 form be completed for each subcontractor and material supplier working on the project prior to their starting work via electronic C92 GoFormz (*process to access GoFormz described above*) which will automatically be uploaded to the respective District SharePoint site. This requirement will go into effect immediately for all Local-let projects advertising after 1/31/2021.

Additionally, this requirement allows the Department to accurately and fully track DBE participation, both race-neutral and race-conscious. This is necessary for semi-annual reporting to FHWA.

District LPA staff will grant SharePoint access to the appropriate LPA personnel enabling them to view and monitor project documentation. The Project Engineer or LPA Designee will be required to verify that a C92 GoFormz has been submitted for each subcontractor working on the project, and this requirement will also be routinely monitored by the District Construction Monitor to ensure compliance.

PN126

This Proposal Note must be used on all Local-let Design Build projects using the 2019 C&MS. The note revises Section 100 – General Provisions of the ODOT 2019 C&MS to be specific for LPAs. PN126 closely resembles the same note used on ODOT-let Design Build projects. The major update is the Prime Contractor's contractual obligation to make payment to each consultant, subcontractor, and supplier within 10 Calendar Days after receipt of payment from either the Department or LPA. Also, the Prime Contractor shall ensure this contractual obligation is placed in all consultants, subconsultants, subcontractor and supplier contracts that it enters into and further require that all consultants, subconsultants subcontractor and suppliers place the same payment obligation in each of their lower tier contracts.

For reference purposes, the Local-let Design Build Bid Doc Template may be found in the Forms/Bid Preparation Section at the following web page address:

https://www.transportation.ohio.gov/wps/portal/gov/odot/working/publications/local-let-manual

Commercially Useful Function (CUF) Training

Training for CUF and Prompt Payment is located at the following web address:

http://www.dot.state.oh.us/Divisions/Planning/LocalPrograms/LTAP/Pages/Ohio_LTAP_eLearning.aspx

Additional Updates to the LATP Manual of Procedures – Construction Chapter

Clarification on Retainage Requirements

In accordance with Article XVIII, Section 3 of the Ohio Constitution, and Ohio's home rule law, the Department allows LPA program recipients the full flexibility to withhold retainage from the prime in strict accordance with sections 153.12 and 153.14 of the Revised Code, and pursuant to 49 CFR 26.29(b)(3).

Should an LPA exercise its option to retain funds, it must be done so in strict accordance with the rules outlined above. Additionally, LPAs who choose to do so, shall monitor the return of retainage and may withhold retainage by selecting one of three specified methods outlined in 49 CFR 26.29(b)(3):

(1) LPA may decline to hold retainage from prime contractors and prohibit prime contractors from holding retainage from sub-contractors.

(2) LPA may decline to hold retainage from prime contractors and require a contract clause obligating prime contractors to make prompt and full payment of any retainage kept by prime contractor to the subcontractor within 30 days after the subcontractor's work is satisfactorily completed.

(3) LPA may hold retainage from prime contractors and provide for prompt and regular incremental acceptances of portions of the prime contract, pay retainage to prime contractors based on these acceptances, and require a contract clause obligating the prime contractor to pay all retainage owed to the subcontractor for satisfactory completion of the accepted work within 30 days after your payment to the prime contractor.

FHWA Form 1273

A process has been outlined in the Construction Chapter of the LPA Manual of Procedures to ensure that the FHWA Form 1273 is physically incorporated into all Local-let construction contract and subcontract agreements (excluding purchase orders, rental agreements and other agreements for supplies or services). The LPA will be required to collect all contracts, subcontracts, and lower-tier contracts on the project from the Prime Contractor to verify Form FHWA-1273 has been physically incorporated. The LPA must then affirm the physical incorporation of Form FHWA-1273 by completing Appendix M – Form FHWA-1273 Subcontract Agreement Check.

The Construction Chapter of the LPA Manual of Procedures may be found at the following web page address: https://www.transportation.ohio.gov/wps/portal/gov/odot/working/publications/local-let-manual

Ensuring Continued Compliance

Moving forward, ODOT has committed to meet required corrective actions outlined in the Conciliation Agreement and ensuring that the Local-let Program is compliant with the DBE program requirements and regulations.

If there are any additional questions or comments, please do not hesitate to contact any of the individuals listed below.

Contact Information:

Any questions regarding the update outlined above should be directed to the following:

Office of Local Programs:

Jeff Peyton: 614-466-2032

Jeff Shaner: 614-644-6394

All questions regarding the **GoFormz** application can be directed to the following email address GoFormz.Help@dot.ohio.gov or the Admin Owners below.

GoFormz Admin Owners:

Janet Treadway: 614-466-7514

Tia Williams-Hayes: 614-644-6463

Appendix E

Code of Federal Regulations

Title 2 - Grants and Agreements

Volume: 1
Date: 2015-01-01
Original Date: 2015-01-01
Title: Section Â§ 200.322 - Procurement of recovered materials.
Context: Title 2 - Grants and Agreements. Subtitle A - Office of Management and Budget Guidance for Grants and Agreements. CHAPTER II - OFFICE OF MANAGEMENT AND BUDGET GUIDANCE. - Reserved. PART 200 - UNIFORM ADMINISTRATIVE REQUIREMENTS, COST PRINCIPLES, AND AUDIT REQUIREMENTS FOR FEDERAL AWARDS. Subpart D - Post Federal Award Requirements. - Procurement Standards.

§ 200.322 Procurement of recovered materials.

A non-Federal entity that is a state agency or agency of a political subdivision of a state and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

[78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75885, Dec. 19, 2014]

Prohibition on Covered Telecommunications and Video Surveillance Services or Equipment

Grants and Loans

This document is designed to address common questions regarding the Office of Management and Budget's (OMB) implementation of section 889(b) of the National Defense Authorization Act (NDAA) of Fiscal Year 2019, Pub. L. No. 115—232, for grants and loans through the updates to section 200.216 of Title 2 of the Code of Federal Regulations (2 CFR).

Table of Contents

Q-1. What are "covered telecommunications equipment or services"?

Section 889 of the NDAA of 2019 defines "covered telecommunications equipment or services" to mean telecommunications and video surveillance equipment or services produced by Huawei Technologies Company, ZTE Corporation, Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

"Covered telecommunications equipment or services" also includes telecommunications or video surveillance equipment or services provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity that is owned or controlled by the government of a covered foreign country. Additional entities identified as covered entities will be identified as described in Q-2.

Q-2. How do you know if an entity has been added to the list of covered entities?

Entities added to this list will be incorporated into the excluded parties list in the System for Award Management (SAM) (www.sam.gov). When a user conducts a search of the excluded parties list, a record will appear describing the nature of the exclusion for any entity identified as covered by this prohibition.

Q-3. What is the covered foreign country?

The People's Republic of China.

Q-4. Can this prohibition be waived for grants and loans?

Unlike Federal procurement, the prohibition cannot be waived for Federal assistance such as grants and loans.

Q-5. Is it mandatory to include a specific provision in Federal awards and notices of funding opportunity issued on or after August 13, 2020?

The Federal awarding agency must take positive steps to ensure that recipients are aware of the requirements associated with this provision as of August 13, 2020. While referencing 2 CFR Part 200 may likely suffice, including a specific provision may be a best practice in order to ensure clarity, especially because this is a new requirement.

Q-6. Does the Section 889 prohibition apply to existing Federal awards as of August 13, 2020?

Yes. The section 889 prohibition on covered telecommunications and video surveillance services or equipment is effective on all expenditures charged to Federal awards as of August 13, 2020.

Q-7. Will this prohibition impact fixed amount awards where payment is based upon the achievement of milestones and not based on actual costs?

Yes, the prohibition on covered telecommunications and video surveillance services or equipment applies and the recipient's budget must not include the cost of covered telecommunications and video surveillance services or equipment in their fixed amount award.

Q-8. Can a Federal award be provided to a recipient when they use covered telecommunications equipment or services?

Yes, as long as the Federal award does not pay for the covered telecommunications and video surveillance services or equipment that the recipient uses. If the Federal agency suspects that the goods and services being procured under the award may in fact be prohibited, it must take appropriate action, consistent with its policies and procedures, and in accordance with the guidance in 2 CFR Part 200.

Q-9. Do existing Federal awards need to be amended to include the provision after August 13, 2020?

This prohibition applies to existing Federal awards. Federal awarding agencies must ensure that recipients are aware of this prohibition and determine if an amendment is needed on a case by case basis.

Q-10. If a Federal award issued prior to August 13, 2020 is amended for non-financial purposes (i.e., no cost extension or scope), does the amendment need to include this prohibition?

This prohibition applies to existing Federal awards. Federal awarding agencies must ensure that recipients are aware of this prohibition and determine if an amendment is needed on a case by case basis.

Q-11. If a Federal award issued prior to August 13, 2020 is amended for the purposes of adding supplemental funds, does the amendment need to include this prohibition?

This prohibition applies to existing Federal awards. Federal awarding agencies must ensure that recipients are aware of this prohibition and determine if an amendment is needed on a case by case basis.

Q-12. Can a Federal award be used to procure goods or services, unrelated to prohibited services or equipment, from an entity that uses such equipment and services?

Yes.

Q-13. Do recipients need to certify that goods or services procured under a Federal award are not for covered telecommunications equipment or services?

Yes, when the recipient signs an award agreement they are certifying that they will comply with all applicable laws, rules, and regulations, including the prohibition on covered telecommunications equipment and services. If the Federal agency suspects that the goods and services being procured under the award may in fact be prohibited, it must follow its own policies and procedures to take appropriate action that aligns with the guidance in 2 CFR Part 200. OMB is separately evaluating the certifications and representations statement in SAM and will make any necessary updates.

Q-14. Can recipients use the costs associated with covered telecommunications equipment or services or equipment to meet their cost sharing or match requirements?

No, such costs are unallowable costs.

Q-15. Can recipients use program income generated by a Federal award to cover the costs associated with covered telecommunications equipment or equipment?

No. Program income must be used for allowable costs in accordance with 2 CFR §200.307.

Q-16. Will this prohibition impact awards that use the de minimis indirect cost rate, as the 10% is based on modified total direct costs (MTDC) and not specific indirect costs elements?

No, the prohibition on covered telecommunications and video surveillance services or equipment does not affect a non-Federal entity's use of the de minimis indirect cost rate; however, the non-Federal entity must review its costs used to determine its de minimis indirect cost rate to ensure that unallowable costs are not included in the calculation. The MTDC cannot include unallowable costs in its calculation of the de minimis indirect cost rate.

Q-17. When a recipient normally charges prohibited services or equipment through their indirect cost pool, can a Federal award cover the same recipient's indirect costs?

No, like other unallowable costs, covered telecommunications and video surveillance services or equipment costs must not be charged either directly or indirectly to Federal awards. The recipient must separately negotiate an indirect cost rate for their Federal awards that excludes these costs from the indirect cost pool and base amount chargeable to its Federal award(s).

Q-18. How will covered telecommunications equipment or services as a new unallowable expense be implemented for indirect cost rates?

Federally approved indirect cost rate agreements generally do not need to be reopened or amended, but may need to be adjusted in accordance with 2 CFR § 200.411. The non-Federal entity must review its current indirect cost rate proposal or previously negotiated rate to ensure that it does not include expenses associated with covered telecommunications equipment or services because the non-Federal entity must certify that the costs included in its proposal are allowable.[1]

- If a non-Federal entity has not included the covered telecommunications equipment or services, then it should include a statement with each indirect cost proposal affirming that it has not included any costs described in 2 CFR §200.216.

- If a non-Federal entity finds that it has included the covered telecommunications equipment or services in an indirect cost proposal currently under review or a previously negotiated rate, then it should immediately contact the cognizant agency for indirect costs to revise the indirect cost proposal or negotiated rate.

Q-19. How will Federal agencies identify covered telecommunications and video surveillance services or equipment as unallowable costs in the negotiation and random audit selection of indirect costs?

Federal agencies must adapt their policies and procedures to review the costs associated with the prohibited telecommunications and video surveillance services or equipment. 2 CFR Part 200 requires the recipient to certify that all costs within the negotiated indirect cost rate are allowable in accordance with 2 CFR Part 200, Subpart E (Cost Principles). The covered telecommunications and video surveillance services or equipment mentioned in Sec. 889 of the NDAA of 2019 are considered unallowable under 2 CFR Part 200, Subpart E (Cost Principles).

[1] 2 C.F.R. Part 200, Appendix III (F), Certification; Appendix IV (D), Certification of Indirect (F&A) Costs; Appendix VII (D.3), Required Certification.

Q-20. What are the Federal awarding agencies' responsibilities to monitor adherence to this provision?

Federal awarding agencies are responsible for the implementation of this provision, as they are for the other compliance requirements in 2 CFR Part 200, and must incorporate oversight of this provision into their existing the monitoring and compliance oversight of Federal awards. Adherence to these new requirements will also be reviewed for costs incurred on or after August 13, 2020 in future Single Audits and other audits of recipient spending.

Q-21. How should a Federal awarding agency handle a recipient that procured covered telecommunications equipment or services or equipment under a Federal award?

If a recipient procures covered technology under a Federal award, the Federal awarding agency must follow its policies and procedures associated with monitoring Federal awards and, when appropriate, pursue remedies for noncompliance, which must align with the guidance provided in 2 CFR Part 200.

SAM.GOV

Exclusion Search Results 17 Total Results

Filtered by:

Keyword	Status
Hangzhou Hytera Huawei Zhejiang ZTE dahua	Active
	Inactive

Dr. Zhiwei Wang • Active

DUNS **Unique Entity ID:**

SAM **Unique Entity ID:**

Excluding Agency: HEALTH AND HUMAN SERVICES, DEPARTMENT OF

Activation Date: Jul 21, 2020

Classification: Individual

Termination Date: Jul 20, 2030

HANGZHOU HONGYAN TRADING CO., LTD • Active

DUNS **Unique Entity ID:**

SAM **Unique Entity ID:**

Excluding Agency: OFFICE OF FOREIGN ASSETS CONTROL

Activation Date:

Classification: Special Entity Designation

Termination Date: Indefinite

ZTE Corporation • Active

DUNS **Unique Entity ID:** 654608660

SAM **Unique Entity ID:** HWEKRJ3F3N29

Excluding Agency: GENERAL SERVICES ADMINISTRATION

Activation Date: Dec 13, 2019

Classification: Firm

Termination Date: Indefinite

Huawei Investment & Holding Co., Ltd. • Active

DUNS **Unique Entity ID:** 544957314

SAM **Unique Entity ID:** Y3NYMV2P5446

Excluding Agency: GENERAL SERVICES ADMINISTRATION

Activation Date: Dec 13, 2019

Classification: Firm

Termination Date: Indefinite

Hangzhou Hikvision Digital Technology Co., Ltd. • Active

DUNS **Unique Entity ID:** 545259848

SAM **Unique Entity ID:** L78SCHFL4JN8

Excluding Agency: GENERAL SERVICES ADMINISTRATION

Activation Date: Dec 13, 2019

Classification: Firm

Termination Date: Indefinite

Hytera Communications Corporation Limited • Active

DUNS **Unique Entity ID:** 654702463

SAM **Unique Entity ID:** DUKCMD4EJJG8

Excluding Agency: GENERAL SERVICES ADMINISTRATION

Activation Date: Dec 13, 2019

Classification: Firm

Termination Date: Indefinite

Zhejiang Dahua Technology Co., Ltd. • Active

DUNS **Unique Entity ID:** 545242687

SAM **Unique Entity ID:** ED47N4Z1K8S9

Excluding Agency: GENERAL SERVICES ADMINISTRATION

Activation Date: Dec 13, 2019

Classification:

Termination Date:

Firm | Indefinite

HONGYUAN MARINE CO LTD Active

DUNS **Unique Entity ID:**
SAM **Unique Entity ID:**

Excluding Agency: OFFICE OF FOREIGN ASSETS CONTROL
Classification: Special Entity Designation

Activation Date: Jan 10, 2020
Termination Date: Indefinite

Zhongli DING Active

DUNS **Unique Entity ID:**
SAM **Unique Entity ID:**

Excluding Agency: OFFICE OF FOREIGN ASSETS CONTROL
Classification: Individual

Activation Date: Dec 07, 2020
Termination Date: Indefinite

SHANGHAI GANG QUAN TRADE CO. Active

DUNS **Unique Entity ID:**
SAM **Unique Entity ID:**

Excluding Agency: OFFICE OF FOREIGN ASSETS CONTROL
Classification: Special Entity Designation

Activation Date: May 17, 2017
Termination Date: Indefinite

SHANGHAI NORTH TRANSWAY INTERNATIONAL TRADING CO. Active

DUNS **Unique Entity ID:**
SAM **Unique Entity ID:**

Excluding Agency: OFFICE OF FOREIGN ASSETS CONTROL
Classification: Special Entity Designation

Activation Date: May 17, 2017
Termination Date: Indefinite

Yueyue SHEN Active

DUNS **Unique Entity ID:**
SAM **Unique Entity ID:**

Excluding Agency: OFFICE OF FOREIGN ASSETS CONTROL
Classification: Individual

Activation Date: Dec 07, 2020
Termination Date: Indefinite

Huawei Technologies Co., Ltd. Active

DUNS **Unique Entity ID:** 654292358
SAM **Unique Entity ID:** DCAMUHE5N6W1

Excluding Agency: DEPT OF THE AIR FORCE
Classification: Firm

Activation Date: Feb 21, 2019
Termination Date: Indefinite

Huawei Device Co., Ltd. Active

DUNS **Unique Entity ID:** 421306185
SAM **Unique Entity ID:** JKTPF89M9P73

Excluding Agency: DEPT OF THE AIR FORCE
Classification: Firm

Activation Date: Feb 21, 2019
Termination Date: Indefinite

HUAWEI DEVICE USA INC. Active

DUNS **Unique Entity ID:** 078284967
SAM **Unique Entity ID:** LCF7TMLFD2J2

Excluding Agency: DEPT OF THE AIR FORCE
Classification: Firm

Activation Date: Feb 21, 2019
Termination Date: Indefinite

Zuoyou LIN Active

DUNS **Unique Entity ID:**

SAM **Unique Entity ID:**

Excluding Agency:
OFFICE OF FOREIGN ASSETS CONTROL

Classification:
Individual

Activation Date:
Sep 03, 2020

Termination Date:
Indefinite

Daniel Y. HE Active

DUNS **Unique Entity ID:**

SAM **Unique Entity ID:**

Excluding Agency:
OFFICE OF FOREIGN ASSETS CONTROL

Classification:
Individual

Activation Date:
Oct 19, 2020

Termination Date:
Indefinite

Appendix E

Title VI Requirements

The City of Canton, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat.252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

No person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity, for which the Recipient receives Federal financial assistance from DOT, including the City of Canton.

Please also review Appendix A, Appendix C, Appendix D and Appendix E of the Standard Assurances which are included in the following pages.

APPENDIX A

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. **Compliance with Regulations:** The contractor (hereinafter includes consultants) will comply with the Acts and the Regulations relative to Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, ***The City of Canton,*** as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.

2. **Non-discrimination:** The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part21. ***{Include City of Canton specific program requirements.]***

3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor's obligations under this contract and the Acts and the Regulations relative to Non-discrimination on the grounds of race, color, or national origin. ***{Include City of Canton specific program requirements.]***

4. **Information and Reports:** The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or ***The City of Canton)*** to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so certify to the Recipient or ***The City of Canton),*** as appropriate, and will set forth what efforts it has made to obtain the information.

5. **Sanctions for Noncompliance:** In the event of a contractor's noncompliance with the Non• discrimination provisions of this contract, the Recipient will impose such contract sanctions as it or ***The City of Canton*** may determine to be appropriate, including, but not limited to:

   a. withholding payments to the contractor under the contract until the contractor complies; and/or
   b. cancelling, terminating, or suspending a contract, in whole or in part.

6. **Incorporation of Provisions:** The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor will take action with respect to any subcontract or procurement as the Recipient or ***The City of Canton*** may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

APPENDIX C

CLAUSES FOR TRANSFER OF REAL PROPERTY ACQUIRED OR IMPROVED UNDER THE ACTIVITY, FACILITY, OR PROGRAM

The following clauses will be included in deeds, licenses, leases, permits, or similar instruments entered into by the ***(Title of Recipient)*** pursuant to the provisions of Assurance 7(a):

A. The (grantee, lessee, permittee, etc. as appropriate) for himself/herself, his/her heirs, personal representatives , successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree [in the case of deeds and leases add "as a covenant running with the land"] that:

1. In the event facilities are constructed, maintained, or otherwise operated on the property described in this (deed, license, lease, permit, etc.) for a purpose for which a U.S. Department of Transportation activity, facility, or program is extended or for another purpose involving the provision of similar services or benefits, the (grantee, licensee, lessee, permittee, etc.) will maintain and operate such facilities and services in compliance with all requirements imposed by the Acts and Regulations (as may be amended) such that no person on the grounds of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities.

B. With respect to licenses, leases, permits, etc., in the event of breach of any of the above Non-discrimination covenants, *(Title of Recipient)* will have the right to terminate the (lease, license, permit, etc.) and to enter, re-enter, and repossess said lands and facilities thereon, and hold the same as if the (lease, license, permit, etc.) had never been made or issued.*

C. With respect to a deed, in the event of breach of any of the above Non-discrimination covenants, the ***(Title of Recipient)*** will have the right to enter or re-enter the lands and facilities thereon, and the above described lands and facilities will there upon revert to and vest in and become the absolute property of the *(Title of Recipient)* and its assigns.*

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

APPENDIX D

CLAUSES FOR CONSTRUCTION/USE/ACCESS TO REAL PROPERTY ACQUIRED UNDER THE ACTIVITY, FACILITY OR PROGRAM

The following clauses will be included in deeds, licenses, permits, or similar instruments/agreements entered into by ***(Title of Recipient)*** pursuant to the provisions of Assurance 7(b):

A. The (grantee, licensee, permittee, etc., as appropriate) for himself/herself, his/her heirs, personal representatives, successors in interest, and assigns, as a part of the consideration hereof, does hereby covenant and agree (in the case of deeds and leases add, "as a covenant running with the land") that (1) no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination in the use of said facilities, (2) that in the construction of any improvements on, over, or under such land, and the furnishing of services thereon, no person on the ground of race, color, or national origin, will be excluded from participation in, denied the benefits of, or otherwise be subjected to discrimination, (3) that the (grantee, licensee, lessee, permittee, etc.) will use the premises in compliance with all other requirements imposed by or pursuant to the Acts and Regulations, as amended, set forth in this Assurance.

B. With respect to (licenses, leases, permits, etc.), in the event of breach of any of the above Non- discrimination covenants, ***(Title of Recipient)*** will have the right to terminate the (license, permit, etc., as appropriate) and to enter or re-enter and repossess said land and the facilities thereon, and hold the same as if said (license, permit, etc., as appropriate) had never been made or issued.*

C. With respect to deeds, in the event of breach of any of the above Non-discrimination covenants, ***(Title of Recipient)*** will there upon revert to and vest in and become the absolute property of ***(Title of Recipient)*** and its assigns.*

(*Reverter clause and related language to be used only when it is determined that such a clause is necessary to make clear the purpose of Title VI.)

APPENDIX E

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

Pertinent Non-Discrimination Authorities:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d *et seq.,* 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 *et seq.),* (prohibits discrimination on the basis of sex);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. §794 *et seq.),* as amended, (prohibits discrimination on the basis of disability); and 49 CFR Part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 *et seq.),* (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 - 12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 etseq).

CANTON TITLE VI COMPLAINT PROCEDURE

I. FILING A COMPLAINT

Complaint Procedure - Any person who believes that he or she as a member of a protected class, has been discriminated against based on race, color, national origin, gender, age, disability, religion, low income status, or Limited English Proficiency (LEP) in violation of Title VI of the Civil Rights Act of 1964, as amended and its related statutes, regulations and directives, Section 504 of the Vocational Rehabilitation Act of 1973, Americans with Disabilities Act of 1990, as amended, the Civil Rights Restoration Act of 1987, as amended, and any other Federal nondiscrimination statute may submit a complaint. A complaint may also be submitted by a representative on behalf of such a person.

It is the policy of the City to conduct a prompt and impartial investigation of all allegations of discrimination and to take prompt effective corrective action when a claim of discrimination is substantiated.

No one may intimidate, threaten, coerce or engage in other discriminatory conduct against anyone because they have taken action or participated in an action to secure rights protected by the civil rights laws. Any individual alleging such harassment or intimidation may submit a complaint by following the procedure printed below.

Any individual who feels that he or she has been discriminated against may submit a written or verbal complaint to the designated Title VI Coordinator. A complaint must include the name, address and telephone number of the individual making the complaint (complainant) and a brief description of the alleged discriminatory conduct including the date of harm. An individual submitting a complaint alleging discrimination may include any relevant evidence, including the names of witnesses and supporting documentation.

Complaints should be directed to the Title VI Coordinator:

_____

Fonda Williams
Deputy Mayor
218 Cleveland Ave S.W., 8th floor
Canton, Ohio 44702
Phone - 330-438-4302
Email – fonda.williams@cantonohio.gov

Within 60 days of the receipt of the complaint the City will conduct an investigation of the allegation based on the information provided and issue a written report of its findings to the complainant. The City will try to obtain an informal voluntary resolution to all complaints at the lowest level possible.

A complainant's identity shall be kept confidential except to the extent necessary to conduct an investigation. All complaints shall be kept confidential.

These procedures do not deny the right of any individual to file a formal complaint with any government agency or affect an individual's right to seek private counsel for any complaint alleging discrimination.

Complaints may also be filed with the following government agencies:

Ohio Department of Transportation
Office of Equal Opportunity
1980 West Broad Street
MS: 3270
Columbus, OH 43223

The U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Ohio Civil Rights Commission
Central Office
Rhodes State Office Tower
30 East Broad Street, 5th floor
Columbus, OH 43215
614-466-2785

Ohio Civil Rights Commission
Akron Regional Office
Bradley S. S. Dunn, Regional Director
Akron Government Bldg.
161 S. High Street, Suite 205
Akron, OH 44308
(330) 643-3100

Link to filing a complaint online with the Ohio Civil Rights Commission:

https://crc.ohio.gov/FilingaCharge/ChargeFilingProcedure.aspx

Ⅱ. COMPLAINT PROCESSING

The Title VI Coordinator will review the complaint upon receipt to ensure that all required information is provided, the complaint meets the filing deadline date which is 180 days from the date the alleged discriminatory act occurred, and falls within the jurisdiction of the City.

The Title VI Coordinator will then investigate the complaint. If the complaint is against the City then the Mayor's office or their designee will investigate the complaint. Additionally, a copy of the complaint will be forwarded to the City Law Director.

If the complaint warrants a full investigation, the Complainant will be notified in writing by certified mail. This notice will name the investigator and/or investigating agency.

The party alleged to have acted in a discriminatory manner will also be notified by certified mail as of the complaint. This letter will also include the investigator's name and will request that this party be available for an interview.

Any comments or recommendations from legal counsel will be reviewed by the Title VI Coordinator, Director of Public Service and Mayor's office.

Once the City has investigated the report findings, the City will adopt a final resolution. All parties associated with the complaint will be properly notified of the outcome of the City's investigative report.

If the complainant is not satisfied with the results of the investigation of the alleged discriminatory practice(s), she/he shall be advised of their right to appeal the City's decision.

Appeals must be filed within 180 days after the City's final resolution. Unless new facts not previously considered come to light, reconsideration of the City's determination will not be available.

The foregoing complaint resolution procedure will be implemented in accordance with the Department of Justice guidance manual entitled "Investigation Procedures Manual for the Investigation and Resolution of Complaints Alleging Violations of Title VI and Other Nondiscrimination Statues," available online at:

http://www.justice.gov/crt/about/cor/Pubs/manuals/complain.pdf

Title VI Complaint Filing

Complaints filed with the City of Canton, Ohio based on violations of Title VI of the Civil Rights Act of 1964, must include the following information:

· Name of Complainant
· Date of Complaint
· Address of Complainant
· Telephone Number of Complainant
· Name of Agency / Department Accused of Discriminatory Practices
· Name of Individual Accused of Discriminatory Practices
· Address of Agency
· Date of Alleged Discrimination
· Description of Alleged Discrimination (see below)

11. Alleged Discrimination - If your complaint is in regard to discrimination in the delivery of services or discrimination that involved the treatment of you by others by the agency or department indicated above, please indicate below the basis on which you believe these discriminatory actions were taken.
· Race / Color / Religion
· National Origin
· Age · Sex, Gender
· Disability · Income Status
· Explanation of Alleged Discrimination - Please explain as clearly aspossible what happened.
Provide the name(s) of witness(s) and others involved in the alleged discrimination. (Attach additional sheets if necessary and provide a copy of written material pertaining to your case.)
· Signature of Complainant · Date of Complaint

Ⅲ. ENVIRONMENTAL JUSTICE

In accordance with Title VI of the Civil Rights Act of 1964, each Federal agency shall ensure that all programs or activities receiving Federal financial assistance that affect human health or the environment do not directly, or through other arrangements, use criteria, methods, or practices that discriminate on the basis of race, color, or national origin. Part of Title VI reads, "No person in the United States shall, on the ground of race, color, or national origin beexcluded

from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving Federal financial assistance."

The three fundamental environmental justice (EJ) principles are:
· To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations andlow-income populations;

· To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process; and

· To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority populations and low-income populations.

The City of Canton is committed to these three environmental justice principles in all work that the City performs.

IV. ADMINISTRATION – WORK PLAN

Pursuant to 23 CFR 200, the City of Canton has designated a Title VI Coordinator who is responsible for initiating, monitoring, and ensuring the City's compliance with Title VI requirements for the following work plan:

· Administer, coordinate and Implement the Title VI Program plan and distribute internally and externally via website and update annually as required.
· Ensure that Assurances are being used in contracts for federal projects.
· Attend Title VI training.
· Collect public involvement data.
· Review written Title VI complaints and ensure every effort is made to resolve complaints informally at the local or regional level and review and update the City's Title VI plan and procedures as required.
· Implement a plan that provides training to City Staff on the basic requirements of the Title VI implementation plan.

Title VI Coordinator:

_____

Fonda Williams
Deputy Mayor
218 Cleveland Avenue, S.W., 8th floor
Canton, Ohio 44702
Phone – 330-438-4302
Email - fonda.williams@cantonohio.gov

V. LIMITED ENGLISH PROFICIENCY (LEP) POLICY

On August 11, 2000, the President signed an executive order, *Executive Order 13166: Improving Access to Service for Persons with Limited English Proficiency (LEP)*, to clarify Title VI of the Civil Rights Act of 1964. It has as its purpose, to ensure meaningful access to programs and services to otherwise eligible persons who are not proficient in the English language. In addition, The US Department of Transportation published *Policy Guidance Concerning Recipients' responsibilities to Limited English Proficient Person* in the December 14, 2005 Federal Register.

This guidance outlines the following four factors that the City uses to access the LEP populations in Canton.

1. The number and proportion of LEP persons eligible to be served or likely to be encountered by the City.
2. The frequency with which LEP individuals come into contact with the program, activity or service.
3. The nature and importance of the program, activity, or service provided by the program.
4. The resources available to the City and costs.

Summary of the four factor analysis

Factor 1- The number and proportion of LEP persons eligible to be served or likely to be encountered by the City can only be estimated until the actual number of persons who can speak English less than "very well" are documented as needing assistance by City Staff . With this Title VI Plan being in early development stages and considered a document that may need regular updates, US Census Bureau information is being used at this time. The total population is provided below to shown general distribution of race and ethnicity in the community. The estimated number of persons that may not speak English "very well" is following in the US Census Bureau 2006-2010 American Community Survey.

The U.S. Census Bureau provides statistics from 2010 for the City of Canton as follows:
Total population = 74,451
Population by Ethnicity:
Hispanic or Latino = 1,805 Non Hispanic or Latino = 72,646
Population by Race:
White = 53,150 African American = 16,854, Asian = 193, American Indiana or Alaska Native = 372,
Native Hawaiian and Pacific Islander = 0, Other = 431, Identified by two or more = 3,451.

The US Census Bureau 2006-2010 American Community Survey 5-Year Estimates under SELECTED SOCIAL CHARACTERISTICS estimates the number of people in Canton who speak a language other than English to be 2,945 with those speaking English less than "very well" estimated at 1.0% or approximately 983 individuals who may be considered limited in English proficiency.

Factor 1(continued)-
According to the census numbers above there may be up to 983 individuals who live in the City of Canton that *may* be considered as LEP. Based on actual contact between City Staff and the community there have been very few requests from anyone in the service area asking the City to provide language translation services. Therefore, the LEP population is probably even less than the estimate shown above.

Factor 2- The frequency with which LEP individuals come into contact with the program, activity or service:
Due to the infrequent requests for translation services, there appears to be a minimal need for translation services from the City. This may be attributed to the high percentage of younger people (87.6% for ages up to 17) who are available as family members for translation services.

Factor 3. The nature and importance of the program, activity, or service provided by the program:
If at any time a LEP individual requests translation services that are considered important such that denial or delay of access or services or information could have serious or even life-threatening implications, the City will provide, upon request, services to assist the LEP population including translation of vital City documents and interpretation services.

Factor 4. The resources available to the City and costs:
The City of Canton currently has several staff members who are bilingual in English and Spanish and are available to translate requests from the Hispanic population on a day to day basis. The City also provides many of their outreach services in the predominate languages of the community, English and Spanish. In addition, certified translation services are available through LanguageLine Solutions, a telephone translation service that is accessible for phone line translations services 24 hours a day. These are services the City provides upon request as discussed in factor 3 above. Page | 12

Summary of LEP Accommodation Plan

· The City of Canton strives to serve its population to the best of its ability and will provide upon request, services to assist the LEP population including translation of vital documents and interpretation services deemed necessary to provide meaningful access to City services.
· A U.S. Census Bureau ISpeak card is available as part of this document and on the City's webpage and is also available at City Hall located at 414 Main Street. This card allows LEP individuals to communicate their preferred language to City Staff whereas City Staff may then access a translation service called LanguageLine, phone number 1-800-752-6096 is available to City Staff or other translation services may be used as determined by the City.
· For language translation requests from the Hispanic or Latino community the City has several staff member who are bilingual and are available to provide translation services on a day to day basis.
· The City of Canton utilizes a voluntary public involvement survey to collect information regarding persons affected by proposed projects. The survey permits respondents to remain

anonymous, while voluntarily answering questions regarding their gender, ethnicity, race, age, sex, disability status, and household income. This voluntary public involvement survey is available at all public hearings and meetings. Once the survey data has been collected, it will be reviewed and then the survey will be placed in a file for future reference. In the case enough surveys are collected over time to show a significant increase in LEP populations, the City may consider changes to their LEP policy. Completed surveys shall be retained for a period of three years from the date of the meeting and/or completion of the related project, if applicable. See Appendix G for a sample of this Survey.

· The City reviews written Title VI complaints and ensures every effort is made to resolve complaints informally at the local or regional level and review and update the City's Title VI plan and procedures as required.

· Staff for the City will be provided training on the requirements for providing meaningful access to services for LEP persons. Considering the relatively small size of the City of Canton and limited financial resources, current training may be limited to web access to this document and it's attachments by all City Staff, a log showing the names of all Staff that have been made aware of this document (sign off that they have read the document) and require that all new employees receive the same training.

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

MODIFIED STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

[Where Third Party Engineer Performs Construction Administration Duties]

Prepared by

EJCDC®
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

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National Society of Professional Engineers®

These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters or with all capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement or Owner-Contractor Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Owner concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with any procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times, or both; contesting Owner's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Owner has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and

Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract. Only printed or hard copies of the items in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 13.03 in the case of Unit Price Work).

15. *Contract Times*—The number of days or the dates stated in the Agreement by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work so that it is ready for final payment.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work and has entered into the Agreement.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Design Professional*- architects; civil, structural, mechanical, electrical, plumbing, and heating, ventilating, air conditioning, and other engineers; interior designers; landscape architects; and others whose services have traditionally been considered "professional" activities, require licensing or registration by the state, or otherwise require the knowledge and application of design principles appropriate to the project at hand.

19. *Drawings*—The part of the Contract Documents prepared or approved by the Engineer that graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

20. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed by the Owner.

21. *Engineer*—The individual or entity named identified in the Agreement.

22. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

23. *General Requirements*—Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, *statutes*, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*—Charges, security interests, or *encumbrances* upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an *intermediate* completion date or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor may start to perform the Work. *Owner*—The individual or entity with which *Contractor* has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract. The Owner is the City of Canton.

30. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times. The Progress Schedule is sometimes called the Construction Schedule.

31. *Project—The* total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

32. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing *the* Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

34. *Samples*—Physical examples of materials, equipment, or workmanship that are *representative* of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.

36. *Schedule of Values*—For non unit price items, a schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or *information* that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *Site*—Lands or areas indicated in the *Contract* Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and

workmanship as applied to the *Work*, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a *direct* contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof. Substantial Completion is further defined as (i) that degree of completion of the Project's operating facilities or systems sufficient to provide Owner the full time, uninterrupted, and continuous beneficial operation of the Work; ii) all required functional, performance, and acceptance or startup testing has been successfully demonstrated for all components, devices, equipment, and instrumentation and control; and (iii) all traffic control and safety devices are in place and operational to the satisfaction of Engineer in accordance with the requirements of the Specifications.

42. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

43. *Supplementary Conditions*—The part of the Contract Documents that amends or supplements these General Conditions.

44. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

45. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

46. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

47. *Unit Price Work*—Work to be paid for on the basis of unit prices.

48. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

49. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to respond to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. Intent of Certain Terms or Adjectives:

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. Day:

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. Defective:

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

   a. does not conform to the Contract Documents; or

   b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

   c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. Furnish, Install, Perform, Provide:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use

any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Contractor's Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured identified in the Modified General Conditions Owner-approved copies of certificates of insurance, copies of endorsements, and other evidence of insurance which either of them or any additional insured may reasonably request, which Contractor is required to purchase and maintain in accordance with Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor one fully executed Agreement in electronic format.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. for Work items not covered by unit prices, a preliminary Schedule of Values which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices shall be broken down into labor & materials. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work. The total of the Schedule of Values prepared for the Work items not covered by unit prices, as required by these Modified General Conditions, shall not exceed the Bid submitted for said Work, unless such amount is adjusted as provided in the Contract Documents.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

A. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer and Owner.

1. The Construction/Progress Schedule shall be prepared as provided in the Contract Documents.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. For non-unit price Work, Contractor's Schedule of Values will be acceptable to Owner and Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work. Such prices shall be broken down into labor & materials. Once approved by the Owner and Engineer, the Contractor will not change the allocation of the Contract Price to the component parts of the Work without the Owner and Engineer's written approval. The Owner and/or Engineer thereafter may from time to time require the Contractor to adjust such schedule if the Owner and/or Engineer determines it to be in any way unreasonable or inaccurate. The Contractor then shall adjust the schedule of values as required by the Owner and/or Engineer within ten (10) days.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

B. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

A. Standards Specifications, Codes, Laws and Regulations

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code,

or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of Owner's officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies:

1. *Contractor's Verification of Figures and Field Measurements*: In addition to its obligations under the Instructions to Bidders, before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Owner, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof or Contractor failed to perform its obligations under the Instructions to Bidders.

4. In addition to its obligations under the Instructions to Bidders, if Contractor proceeds with work that Contractor had actual knowledge or should have known that a conflict, error, ambiguity, or discrepancy existed as indicated above, correction or work constructed without notification to Engineer shall be at Contractor's expense, (except in an emergency as authorized by Paragraph 7.15).

B. Resolving Discrepancies:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

   a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

   b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the

provisions of the Contract Documents would result in violation of such Law or Regulation).

2. Within the Contract Documents, requirements of the Agreement shall take precedence over the Modified General Conditions, which shall take precedence over the Specifications, which shall take precedence over the Drawings.

3. Within a particular Contract Document, figure dimensions on Drawings shall take precedence over general Drawings. Specific instructions or specifications shall take precedence over the general instructions or specifications.

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by filing a Claim.

C. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run in accordance with Section 3 of the Agreement.

4.02 *Starting the Work*

A. Contractor may start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in the Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes

in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by Professional Surveyor (P.S.) registered in the state of Ohio. Contractor is referred to the General Requirements for additional requirements for laying out the Work.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Construction Schedule established in accordance with the Contract Documents.

1. **The Date for Substantial Completion shall be changed or modified only by Change Order, other Modification, or a Claim that is Finally Resolved, regardless of the date in the Construction Schedule.**

2. The float in the Construction Schedule and any updates to it shall belong to the Owner. Float shall mean the amount of time by which activities may be delayed without affecting the Contract Date for Substantial Completion.

3. The Contractor's obligation to furnish scheduling information is a material term of its Contact. If the Contractor fails to furnish requested scheduling information in writing within five (5) days of a request for such information from the Engineer or Owner, the Contractor shall pay and the Owner may withhold from the Contractor Liquidated Damages at the rate of Fifty Dollars ($50.00) a day for each calendar day thereafter that the Contractor fails to furnish the requested information.

B. **THE PERIODS OF TIME IN THE PROJECT CONSTRUCTION SCHEDULE ARE OF THE ESSENCE TO THIS CONTRACT. THE CONTRACTOR SHALL PROSECUTE ITS WORK IN ACCORDANCE WITH THE CURRENT PROJECT CONSTRUCTION SCHEDULE.**

1. **Notice of Delays.** As a condition precedent to any increase in the Contract Price and/or Contract Times, the Contractor shall give the Owner and the Engineer verbal notice of any delay affecting its Work within two (2) business days of the commencement of the delay. In addition and also as a condition precedent to any increase in the Contract Price and/or Contract Times, the Contractor shall give the Owner and Engineer written notice of the delay within ten (10) business days of the commencement of the delay with specific recommendations about how to minimize the effect of the delay. The written notice of the delay shall conspicuously state that it is a **"NOTICE OF DELAY."** A notice of delay shall not constitute the submission of a Claim. Contract Times shall only be changed as provided in the Agreement. The Contractor acknowledges and agrees that these notice provisions are material terms of the Contract Documents and give the Owner the opportunity to take action to minimize the cost and/or effect of delays.

4.05 *Delays in Contractor's Progress*

A. Excusable, Compensable Delays. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Non-Excusable Delays. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. Excusable, Non-Compensable Delays. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the

Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph; it being understood and agreed that the Contractor has included in the Contract Price a contingency for the risk of such delays. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
2. weather conditions as provided in Paragraph 4.05.H;
3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

H. Weather Delays. When the Contractor is prevented from completing any part of the Work on the critical path within the Contract Time due to weather conditions, if a Claim is made as provided for in these Modified General Conditions, the Contract Time will be extended by one (1) day for each work day lost due to weather that delays Work on the critical path in excess of those in the following table:

Month	Number of Workdays Lost Due To Weather
January	8
February	8
March	7
April	6
May	5
June	4
July	4
August	4
September	5
October	6
November	6
December	6

I. A work day will be lost due to weather only when weather conditions reduce production by more than 50 percent on Work on the critical path. Production shall be measured by hours worked. The Contractor shall have the burden of establishing that weather conditions reduced the production by more than 50 percent on Work on the critical path.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a Notice of

Commencement prepared for the Project, conforming to the provisions of Ohio Revised Code Section 1311.252.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas:

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, alleged to have been caused by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and

machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Agreement identifies:

1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
3. Technical Data contained in such reports and drawings.
4. It is possible that there may be other reports, and/or tests of subsurface conditions at or contiguous to the Site not prepared by or on behalf of Owner. The Owner makes no representation about such reports and/or tests, assuming they exist.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data contained in such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information. For example, interpolations and extrapolations of Technical Data performed by Contractor to estimate locations or quantities of subsurface strata are independent factual assumptions which Owner does not warrant.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
2. is of such a nature as to require a change in the Drawings or Specifications; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor, as a condition precedent to any increase in the Contract Price and/or an extension of the Contract Times shall, within 48 hours after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15),

notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding determine conditions for the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition and indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. Possible Price and Times Adjustments:

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

   b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and

   c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

   a. Contractor knew or should have known of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

   b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

   c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written

statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, or by others. Unless it is otherwise expressly provided elsewhere in these Modified General Conditions:

1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. protecting all Underground Facilities in a manner at least as cautious and protective of safety and of underground facilities as those methods identified in Ohio Revised Code Sections 3781.25 and 3781.30;

b. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

c. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. *Engineer's Review*: Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; and determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. Possible Price and Times Adjustments:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or

actual location of the Underground Facility in question;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and

d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Agreement identifies:

1. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Contract Documents with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work

in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.

H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a Contract Bond in the amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. Such bond shall be in the form that meets the requirements of the Ohio Revised Code. If the Contractor submitted a combined Bid Guaranty and Contract Bond with its bid for the Work, that form of Bond shall satisfy the Contractor's requirement to provide a Contract Bond. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on

Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury and meet the other requirements of the Contract Documents. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.

D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.

E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

G. *Material Default or Termination.* If the Owner notifies the Contractor's surety that the Contractor is in material default, the surety will complete its investigation of the claimed material default within 21 days. The surety is advised to start looking for a replacement contractor upon notice of material default. As part of its investigation, the surety shall promptly visit the offices of the Contractor, Engineer, and Owner to inspect and copy the available Project records. The Owner, Engineer, and Contractor, upon written request by the surety, shall make such records available during regular business hours for such inspection and copying. The Owner and Engineer's making such records available as provided herein shall satisfy the Owner's obligation to the surety to furnish documents for the investigation. The surety will provide the Owner with the results of its investigation, including any written reports or documents.

If the Owner terminates the Contract and the surety proposes to take over the Work, the surety shall do so no later than the expiration of the 21-day investigation period or 10 days after the date the Owner terminates the Contract, whichever is later. If the Owner terminates the Contract, and the surety proposes to provide a replacement contractor, the replacement contractor shall not be the Contractor or a contractor comprised of mostly Contractor's employees, unless the Owner agrees in writing. In the event the Surety takes over the Project, the surety's obligation shall not be limited to the penal sum of the Bond.

If the surety does not propose an acceptable contractor as required by this Paragraph 6.01.G, the Owner may complete the Work by such means as it deems appropriate. In the event the Owner agrees to accept a replacement contractor, the replacement contractor shall furnish its own bond for the replacement contractor's scope of work, and neither the Contractor nor the surety shall be relieved of their obligations under the Contract Documents.

This Paragraph 6.01.G is in addition to any other rights of the Owner under the Contract Documents and is not intended to create any rights of the surety, including but not limited to the right to take over the Contractor's obligations.

In the event of the Contractor's termination and if the surety does not takeover the Work

as provided in this Paragraph 6.01.G, the Owner may take possession of and use all materials, facilities, and equipment at the Project Site or stored off-site for which Owner has paid in whole or in part.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Contract Documents.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Modified General Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Modified General Conditions, or elsewhere in the Contract Documents), 3 certificates of insurance, copies of endorsements, or when specifically requested by the Owner, 3 certified copies of the insurance policies and a receipt evidencing full payment on the premiums, and other evidence of insurance requested by Owner establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Modified General Conditions, or elsewhere in the Contract Documents), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. Failure of Owner to demand such certificates or other evidence of full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

I. By requiring such insurance and insurance limits herein, Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract Documents.

6.03 *Contractor's Insurance*

A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
4. Foreign voluntary worker compensation (if applicable).

B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
2. claims for damages insured by reasonably available personal injury liability coverage.
3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage:
   a. Such insurance shall be maintained for three years after final payment.
   b. Contractor shall furnish Owner and each other additional insured (as identified in these Modified General Conditions or elsewhere in the Contract Documents) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Broad form property damage coverage.
4. Severability of interest.
5. Underground, explosion, and collapse coverage.
6. Personal injury coverage.
7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.

E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow

form as to each and every one of the underlying policies.

F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Modified General Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Modified General Conditions, or required by Laws or Regulations, whichever is greater:

   a. Commercial General Liability ("CGL"): Bodily injury (including death and emotional distress) and property damage with limits of $1,000,000 each occurrence and $2,000,000 aggregate. CGL shall include: (i) Premises-Operation, (ii) Explosion and Collapse Hazard, (iii) Underground Hazard, (iv) Independent Contractors' Protective, (v) Broad Form Property Damage, including Completed Operations, (vi) Contractual Liability, (vii) Products and Completed Operations, (viii) Personal/Advertising Injury, (ix) Stopgap liability with Ohio Intentional Tort endorsement for $1,000,000 limit, and (x) per project aggregate endorsement.

   b. Automobile Liability, covering all owned, non-owned, and hired vehicles used in connection with the Work: Bodily injury (including death and emotional distress) and property damage with a combined single limit of $1,000,000 per person and $1,000,000 each accident.

   c. Such policies shall be supplemented by an umbrella policy, also written on an occurrence basis, to provide additional protection to provide coverage in the total amount of $1,000,000 for each occurrence and $1,000,000 aggregate for contracts with Contract Price of $250,000 or less; $2,000,000 each occurrence and $2,000,000 aggregate for contracts with a Contract Price greater than $250,000 but less than or equal to $500,000; $3,000,000 each occurrence and $3,000,000 aggregate for contracts with a Contract Price greater than $500,000 but less than or equal to

$1,000,000; and $5,000,000 each occurrence and $5,000,000 aggregate for contracts with a Contract Price greater than $1,000,000.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 30 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.

5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.

6. include products and completed operations insurance.

7. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 5.02 and 7.18.

8. with respect to products and completed operations insurance remain in effect for at least two years after final payment.

   a. Contractor shall furnish Owner and each other additional insured identified in these Modified General Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

K. The following provisions shall also apply to the insurance provided by the Contractor:

   1. Contractor's insurance shall be primary and non-contributory.

   2. Insurance policies shall be written on an occurrence basis only.

   3. The Contractor shall require all Subcontractors to provide Workers' Compensation, CGL, and Automobile Liability Insurance with the same minimum limits specified herein, unless the Owner agrees to a lesser amount.

   4. Owner shall be named as a certificate holder on the policies of insurance maintained by Contractor. The Contractor shall provide each additional insured with a certificate of insurance.

   5. The additional insured endorsement shall be ISO 20 10 10 01 and CG 20 37 10 01 or their equivalents so that Completed Operations liability extends to the additional insured after the completion of the Project.

6.04 *Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Contract Documents, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Contract Documents or required by Laws and Regulations). This insurance shall:

   1. include the Owner, Engineer, and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Contract Documents to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and

any corresponding sections in the Contract Documents, the parties required to be insured shall collectively be referred to as "insureds."

2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Contract Documents. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

6. extend to cover damage or loss to insured property while in transit.

7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

8. allow for the waiver of the insurer's subrogation rights, as set forth below.

9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.

10. not include a co-insurance clause.

11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.

12. include performance/hot testing and start-up.

13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the

purchasing policyholder shall provide a copy of the notice to each other insured.

C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.

F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.05 *Waiver of Rights*

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Modified General Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss

referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Modified General Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

7.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, Shut Down Dates as defined in the Agreement, or any City-recognized holiday.

Contractor may perform Work outside regular working hours or on Saturdays, Sundays, Shut Down Dates as defined in the Agreement, or legal holidays only with Owner's written consent, which will not be unreasonably withheld. Contractor (and Subcontractor) regular working hours consist of 8 up to 10 working hours within an 11-hour period between 7:00 a.m. and 6:00 p.m., on a regularly scheduled basis, excluding Saturday, Sunday, and holidays. Overtime work is work in excess of 40 hours per week. Contractor must receive advanced written approval from the Owner prior to performing work on weekends or City Holidays. Approval of such weekend and/or holiday work is in the Owner's sole discretion.

7.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment. Contractor warrants that all materials and equipment are suitable and fit for the intended use of such materials and equipment and are free from defects in material, workmanship, or design. The foregoing applies whether the materials or equipment are specified in the Contract Documents.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 *"Or Equals"*

A. Substitutions prior to the receipt of bids shall be governed by the Instructions to Bidders. Substitutions after the entry into the Agreement shall be governed by these Modified General Conditions. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

   a. in the exercise of reasonable judgment Engineer determines that:

      1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

      2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

      3) it has a proven record of performance and availability of responsive service; and

      4) it is not objectionable to Owner.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

a. shall certify that the proposed substitute item will:

1) perform adequately the functions and achieve the results called for by the general design,

2) be similar in substance to that specified, and

3) be suited to the same use as that specified.

b. will state:

1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,

2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

c. will identify:

1) all variations of the proposed substitute item from that specified, and

2) available engineering, sales, maintenance, repair, and replacement services.

d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract Documents to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be

deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, Contractor shall not be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement.

G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.

J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

A. Responsibility for permits will be established by the Instructions to Bidders.

B. A copy of each permit obtained by Owner is available at Owner's office. Contractor shall examine the permits and conform to the requirements contained therein, and such requirements are hereby made part of these Contract Documents as though the same were set forth herein. Failure to examine the permit(s) will not relieve Contractor from compliance with the requirements stated therein.

7.09 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

B. Materials purchased for use or consumption in connection with the proposed Work will be exempt from the State of Ohio Sales Tax, as provided in Section 5739.02 of the Ohio Revised Code, and also from the State of Ohio Use Tax, as provided in Section 5741.01 of the Ohio Revised Code. A Construction Tax Exempt Certificate is included with the Bid Documents.

C. Purchases by the Contractor of expendable items, such as form lumber, tools, oil, greases, fuel, or equipment rentals, are subject to the application of Ohio Sales or Use Taxes.

D. Contractor shall withhold any income taxes due to the Owner for wages, salaries, and commissions paid to its employees for work done under this Agreement and further agrees that any of its subcontractors shall, by the terms of its subcontract, be required to withhold any such income taxes due for work performed under this Agreement.

7.10 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of

engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal.

D. Prevailing Wage Rates. If indicated in the Agreement or Instructions to Bidders, each laborer, worker, or mechanic employed by Contractor, Subcontractor, or other persons performing Work on the Project shall be paid not less than the applicable prevailing rate of wages pursuant to Ohio Revised Code Chapter 4115.

7.11 *Record Documents*

A. Contractor shall maintain in a safe place at the Site two printed record copies of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. The Contractor shall deliver these record documents, samples, and shop drawings to the Engineer, no later than the date for Substantial Completion, for the Engineer's review and transmittal to the Owner.

7.12 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;
2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Contract Documents identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

B. Contractor shall keep at the Site at all times during the progress of the Work as required by law a competent person to comply with OSHA trenching and excavation requirements. The competent person shall be one who is capable of identifying existing and predictable hazards in the surrounding, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. Shop Drawing and Sample Submittal Requirements:

1. Before submitting a Shop Drawing or Sample, Contractor shall have:

   a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

   b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria,

installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. Shop Drawings:

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. Samples:

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Other Submittals*: Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. Engineer's Review:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. Resubmittal Procedures:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than the number of submittal reviews specified in Paragraph 15.01.E.4 of these Modified General Conditions. Engineer will record Engineer's time for reviewing a subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time in accordance with Paragraph 15.01.E.4. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation

to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;
2. recommendation by Engineer or payment by Owner of any progress or final payment;
3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
4. use or occupancy of the Work or any part thereof by Owner;
5. any review and approval of a Shop Drawing or Sample submittal;
6. the issuance of a notice of acceptability by Engineer;
7. any inspection, test, or approval by others; or
8. any correction of defective Work by Owner.

D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

E. Upon final payment, the Contractor must assign and transfer to Owner all guarantees, warranties, and agreements from and with all contractors, subcontractors, vendors, suppliers, and manufacturers regarding their performance, quality of workmanship, or quality of materials supplied in connection with the work. Contractor represents and warrants that all such guarantees, warranties, and agreements will be in place and enforceable by the Owner in accordance with their terms. The Owner, however, will not assume through any assignment or transfer required under this subparagraph any of the Contractor's payment obligations to any entities.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims (whether alleged or proven), demands, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or relating to the performance of the Work or any breach of Contractor's obligations under the Contract Documents, including but not limited to the breach of any warranty provided in the Contract Documents.

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required

of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the Owner will provide for the

coordination of the work at the Site in the Contract Documents.

8.03 *Legal Relationships*

A. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

B. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify Owner and Engineer as required under Paragraph 7.18.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these Modified General Conditions, Owner shall issue all communications to Contractor through Engineer or the Resident Project Representative.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The Engineer's duties and responsibilities during the construction period are in addition to the duties and responsibilities of the Owner's Representative, as referenced in the Agreement. The duties and responsibilities and the limitations of authority of Engineer as a representative of the Owner during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of

construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

A. Owner may furnish a Resident Project Representative to assist Engineer at the Site, assist Engineer in providing more extensive observation of the progress and quality of the Work, and assist in carrying out the Engineer's other responsibilities under the Contract Documents and its agreement with the Owner

B. The duties and responsibilities of the Resident Project Representative may include, but not be limited to, the following:

1. Review schedules and amendment thereto.
2. Attend conferences and meetings with Contractor.
3. Serve as liaison between Owner, Engineer, and Contractor.
4. Conduct on-site observation of the work.
5. Observe tests, equipment, and system startups.
6. Report to Engineer and Owner when clarifications and interpretations of the Contract Documents are needed. Consider, evaluate, and report to Engineer and Owner, Contractor's requests for modification.
7. Maintain orderly records, keep a daily log (when on a part-time basis, keep log for days visiting site).
8. Before project completion, prepare final list of items to be completed or corrected and make recommendations to Owner concerning acceptance of the Work.
9. Review Payment Applications from Contractor.

C. The Resident Project Representative shall not:

1. Authorize any deviation from the Contract Documents or substitutions of materials or equipment, unless authorized by Owner.
2. Undertake any of the responsibilities of Contractor, Subcontractor, or Contractor's superintendent.
3. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction.
4. Advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.
5. Accept shop drawing or sample submittals from anyone other than Contractor.
6. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
7. Authorize Owner to occupy the Project in whole or in part.
8. Participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

10.04 *Rejecting Defective Work*

A. Owner has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.

C. Engineer's authority as to Change Orders is set forth in Article 11.

D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

B. Unit Price Work for which a typical cross section or other detail from the Contract Documents applies shall be paid only up to the quantity determined by using the dimensions provided in the typical cross section or other detail. By way of example, this provision means that if a typical trench width detail in the Drawings shows a maximum width of 30 inches, all pay quantities associated with the actual work of constructing the detail shall be calculated using a trench width not greater than 30 inches. This means that the actual pay quantity could also be less than that based upon a 30 inch wide trench, if the actual trench width is smaller and otherwise in conformance with the Contract Documents, but the Contractor would not be paid more if the actual trench width exceeds 30 inches. Contractor is responsible for determining what actual trench width may be required due to field conditions and applicable laws and regulations existing at the time of its bid.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders*:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

2. *Work Change Directives*: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations. The agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including but not limited to, all direct, indirect, and cumulative costs associated with such change and any and all adjustments to the Contract Sum and the Date for Substantial Completion.

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of Work Change Directive, a Claim may be made therefor as provided in Article 12.

11.03 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or]

2. where the parties do reach a mutual agreement to a lump sum, then by that mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or

3. where the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows, and is the maximum total allowable amount:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action*: Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision*: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

B. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under

Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change. Failure to provide notice to the surety of any such change shall not exonerate the surety from its obligations under the bond.

ARTICLE 12 – CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:

1. Appeals by Contractor of Engineer's decisions regarding Change Proposals;

2. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. *Submittal of Claim*: As a condition precedent to a change in the Contract Price or the Contract Terms, for each Claim the Contractor shall deliver a fully completed Statement of Claim Form, a copy of which form is a Contract Document, to the Engineer and the Owner, within 21 days of the start of the underlying cause of the Claim. The Contractor shall be responsible for substantiating its Claim. The Contractor's failure to deliver a fully completed Statement of Claim form shall be an irrevocable waiver of Contractor's right to any form of additional compensation, be it in time or money, arising out of the Claim or the circumstances underlying the Claim. Further, Contractor's obligation to deliver a fully completed Statement of Claim form within such 21 day period is a material term of the Contract Documents and provides the Owner with the opportunity to mitigate its damages.

C. *Review and Resolution*: Engineer will review each Claim and, within 45 days after receipt of the Statement of Claim Form, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial. In the event the Engineer does not take action on a Claim within said 45 days, the Claim shall be denied.

D. *Final and Binding Results*: Engineer's written action under Paragraph 12.01.C or denial pursuant to Paragraphs 12.01.C.3 or 12.01.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invokes the dispute resolution procedures set forth in Article 17.

E. *False or Fraudulent Claim.* The Contractor shall not knowingly present or cause to be presented to the Owner a false or fraudulent Claim. Knowingly shall have the same meaning as in Section 3729(b) USC of the Federal False Claims Act. If the Contractor knowingly presents or causes to be presented a false or fraudulent Claim, then the Contractor shall be liable to the Owner for the same civil penalty and damages as the United States Government

would be entitled to recover under such Section 3729(a) USC and shall also indemnify and hold the Owner harmless from all costs and expenses, including Owner's attorneys' and consultants' fees and expenses incurred in investigating and defending against such Claim and in pursuing the collection of such penalty, damages, and fees and expenses.

F. *Claim Documentation*. Within ten (10) days of written request from the Owner, Contractor shall make available to Owner or its representative any books, records, or other documents in its possession or to which it has access, including but not limited to Contractor's daily logs/reports, original estimates of Work and applicable agreements, correspondence with subcontractors and suppliers, internal correspondence (including e-mail), accounting records, and other information from which the Contractor's records, and other information from which the Contractor's costs may be derived. To the extent permitted by law, the Owner shall keep the Project accounting records and estimate for the Project confidential. As requested by the Owner, the Contractor shall provide such documents and information in paper copies and/or computer format (including the format of the Contractor's accounting software and/or ASCII format). The Contractor's provision of the requested documents and information shall be a condition precedent to any further proceeding under the Contract Documents or to payment of an Application for Payment.

G. Failure to provide the requested documents shall be a material breach of the Contract, and Contractor shall indemnify Owner for all of Owner's costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to Contractor's failure to comply with this provision. If the Contractor fails to provide the requested documents, the Contractor shall be precluded from presenting such documents in any subsequent dispute resolution proceedings, if the data was reasonably available at the time of the request.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes,

workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Construction Equipment and Machinery

        1) Rentals of all construction equipment and machinery, and the parts thereof in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

        2) Costs for equipment and machinery owned by Contractor and used on the Work will be paid at a rate shown for such equipment in the latest edition of the Associated Equipment Distributors' rental rate manual. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs. Costs will include the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the changed Work. Equipment or machinery with a value of less than $1,000 will be considered small tools. Costs for equipment and machinery owned by Contractor for

which Contractor is seeking monetary compensation due to the equipment and machinery being idled through no cause of Contractor will be paid at half of the Associated Equipment Distributors' rate.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Fees for permits and licenses.

f. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

g. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

h. The cost of utilities, fuel, and sanitary facilities at the Site.

i. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

j. The portion of the costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain, that can be attributed to this Contract.

C. *Costs Excluded*: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered

by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. .

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.

E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract

Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

A. All Work is subject to testing to indicate compliance with Contract Document requirements. Duplicate copies of test results required shall be submitted to Engineer. Testing laboratories used by Contractor are subject to the approval of Owner. Tests and inspection of work may be conducted by Owner or an independent laboratory employed by Owner. Tests may also be performed in the field by Engineer as a basis for acceptance of the Work. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests. Samples required for testing shall be furnished by Contractor at no cost to Owner. In the event that completed Work does not conform to specification requirements during the initial test, the Work shall be corrected and retested for conformance. The entire cost of retesting completed Work shall be borne by Contractor. This shall include the extra cost for inspection to Owner which will be deducted from the final amount due Contractor.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
3. by manufacturers of equipment furnished under the Contract Documents;
4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer. Tests required by the Contract Documents to be performed by Contractor that require test certificates to be submitted to Owner and Engineer for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and Regulations and applicable state and local statutes. In the event state license or

certification is not required, testing laboratories or agencies shall meet the following applicable requirements:

a. "Recommended Requirements for Independent Laboratory Qualification," published by the American Council of Independent Laboratories.

b. Basic requirements of ASTM E329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction" as applicable.

c. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Institute of Standards and Technology or accepted values of natural physical constants.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Owner or Engineer, Contractor shall, if requested by Owner or Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Owner and Engineer timely notice of Contractor's intention to cover the same and Owner and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work and so as not to delay the Project, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Owner or Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this

sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, fails to comply with any requirements of the Contract Documents, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within two (2) business days of a written notice from Owner or Engineer, or such longer time as may be stated in such notice, to correct, or take reasonable steps to commence to correct, defective Work, or to remove and replace, or take reasonable steps to remove and replace, rejected Work in accordance with Paragraph 14.03.D or as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may correct or remedy any such deficiency. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor all the costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under

this Paragraph 14.07. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

B. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. The Engineer-approved version of the Application for Payment form, which includes information on completed Schedule of Values items, is to be used by the Contractor when making an Application for Progress Payment. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. Applications for Payments:

1. At least by the 20th day of the month (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application, and any other supporting documentation required by the Contract Documents or by the Engineer. The Application for Payment will be in the form and submitted with the number of copies of it and all related documents as required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include Contractor's Affidavit with List of Subcontractors and Suppliers with Amounts Withheld; including a certification that Contractor has paid all of its subcontractors and suppliers who were due to be paid with the proceeds of the prior Application for Payment, all using the form provided by Owner and included in the Project Manual.

3. *Retainage.* Partial payments to Contractor for labor performed shall be made at the rate of 92 percent of the amount invoiced through the Application for Payment that shows the total Contract Completion at 50 percent or greater, pursuant to Ohio Revised Code Section 153.14. After the Contract is 50 percent complete as evidenced by payments in the amount of at least 50 percent of the Contract Price to

Contractor, no additional funds shall be retained from payments for labor.

4. Contractor shall submit one original (unless a different quantity is otherwise agreed upon) on 8-1/2 by 11 paper of each lien waiver submitted.

5. Contractor shall submit six copies (unless a different quantity is otherwise agreed upon) of each pay request for approval.

6. No advanced payment for shop drawing preparation will be made. Shop drawing costs will be paid when equipment and materials are delivered and suitably stored on the site.

7. All stored equipment and materials for which payment is requested shall have five copies (unless a different quantity is otherwise agreed upon) of invoices included with the pay request. Equipment shall be identified thoroughly on the invoices, including serial numbers.

8. Payment for the stored equipment and material which are on the site shall not exceed the invoiced amount for each item, less the Contract retainage. The overhead and profit for the stored items shall not be invoiced until the item is installed.

9. Payment for off-site storage is normally reserved for sensitive or very large pieces of equipment that in Engineer's opinion would not be practical to have stored on the site. Payment for off-site stored items shall be limited to 75% of the invoiced value of the item, less Contract retainage. Contractor shall reimburse Owner the Cost of inspecting off-site stored items. When off-site storage is approved, Contractor shall provide Insurance Certificates and Document of Ownership to Owner.

C. *Review of Applications*:

1. Engineer will, within 10 working days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner

or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

   a. to supervise, direct, or control the Work, or

   b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

   c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

   d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or

   e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

   a. the Work is defective, requiring correction or replacement;

   b. the Contract Price has been reduced by Change Orders;

   c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

   d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

   e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents; or

   f. the Contractor is in default of any other Agreement it has with the Owner.

D. Payment Becomes Due:

1. Thirty days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be submitted to the appropriate funding sources for processing (up to 90 days) and payment to contractor.

E. Reductions in Payment by Owner:

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

   a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

   b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

   c. Contractor has failed to provide and maintain required bonds or insurance;

   d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

   e. Owner has incurred extra charges or engineering costs related to submittal

reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. the Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. the Contract Price has been reduced by Change Orders;

i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

l. there are other items entitling Owner to a set off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

4. Items entitling Owner to retain set-offs from the amount recommended include, but are not limited, to the following:

a. Owner compensation to Engineer at an average rate of $200 per each extra personnel hour for labor plus expenses, if applicable, because of the following Contractor-caused events:

1) Return visits to manufacturing facilities to witness factory testing or retesting;

2) Submittal review in excess of two reviews by Engineer for substantially the same Submittal, in accordance with Paragraph 7.16.E of these Modified General Conditions;

3) Evaluation of proposed substitutes and in making changes to Contract Documents occasioned thereby, in accordance with Paragraph 7.05 of these Modified General Conditions; and

4) Overtime worked by Contractor necessitating Engineer or anyone else to work overtime in accordance with Paragraph 7.02 of these Modified General Conditions.

b. Liability for liquidated damages incurred by Owner as set forth in the Contract Documents.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

G. *Time for Completion of Items on Tentative List and Remedies.* The time fixed by the Engineer for the completion of all items on the list accompanying the tentative certificate of Substantial Completion shall not be greater than thirty (30) days. The Contractor shall complete all items on the list within such 30-day period. If the Contractor fails to do so, the Owner in its discretion may perform the Work by itself or others and the cost thereof shall be charged to the Contractor. The Contractor irrevocably designates the Owner as the Contractor's attorney-in-fact to execute a Change Order deducting such cost from the balance of the Contract Price and also any additional costs or expenses incurred by the Owner arising out of or related to the failure of the Contractor to complete such items, including but not limited to attorneys', consultants', and Engineer's fees. The Contractor's warranties under the Contract Documents shall remain in full force and effect

and cover any remedial Work, even if performed by others. If more than one inspection by the Engineer for purposes of evaluating corrected Work is required, it will be performed at the Contractor's expense.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. Owner may at any time request Contractor in writing to permit Owner to take over operation of any part of the Work although it is not substantially complete. A copy of such request will be sent to Engineer, and within a reasonable time thereafter, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If Contractor does not object in writing to Owner and Engineer that such part of the Work is not ready for separate operation by Owner, Engineer will finalize the list of items to be completed or corrected and will deliver such lists to Owner and Contractor together with a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, utilities, insurance, warranties, and guarantees for that part of the Work which will become binding upon Owner and Contractor at the time when Owner takes over such operation (unless they shall have otherwise agreed in writing and so informed Engineer). During such operation and prior to Substantial Completion of such part of the Work, Owner shall allow Contractor reasonable access to complete or correct items on said list and to complete other related Work.

5. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. Application for Payment:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

   d. a list of all disputes that Contractor believes are unsettled; and

   e. a Contractor's Waiver and Release Agreement for itself as of the date of Final Application for Payment and Subcontractors-Suppliers Waiver and Release Agreements for each of its Subcontractors and Suppliers as of the date of the Final Application for Payment.

3. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

4. If Contractor is required to pay prevailing wages, prior to final payment and in accordance with ORC 4115.05, Contractor and its Subcontractors shall each file with Owner an affidavit certifying their compliance with ORC 4115.03 to ORC 4115.16 regarding wages.

B. Engineer's Review of Application and Acceptance:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due*: Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-

offs allowed under the provisions above with respect to progress payments) will become due and will be submitted to appropriate funding sources for processing (up to 90 days) and paid to Contractor.

15.07 *Waiver of Claims*

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;
2. correct such defective Work;
3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or limitation upon, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by

written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) three business days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

Such termination shall be effective as of the date stated in the termination notice provided to Contractor.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within three business days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

16.03 *Owner May Terminate For Convenience*

A. Upon three business days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. Such termination shall be effective as of the date stated in the written notice. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including compensation as set forth in the schedule of values or Bid Form in the case of unit prices;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

C. Contractor shall require similar provisions contained in Paragraph 16.03 in each of its subcontracts to protect Contractor from claims by Subcontractors arising from the Owner's termination for convenience, or to minimize claims by such subcontractors. The remedy provided to Contractor under this Paragraph 16.03 shall be the Contractor's sole remedy in the event of termination for convenience by Owner.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 90 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 90 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Litigation, Settlement, Methods, and Procedures.*

1. Any dispute, claim, or other matter not settled by negotiation or mediation, shall be determined by the Court of Common Pleas for Stark County, Ohio, which shall be exclusive venue and jurisdiction over such matters and claims, to the exclusion of any other court, including any U.S. District Court.

2. In addition to Owner's entitlement to attorneys' fees set forth elsewhere in the Contract Documents, in the event that Contractor files a Claim or files an action against Owner, Owner shall be entitled to make an offer of settlement of the Claim to Contractor at any time up to the date of trial. Such offer of settlement shall not be admissible into evidence at the litigation except on the issue of entitlement to recovery of attorneys' fees, costs, and expenses. If at any stage of the litigation, including any appeals, Contractor's claim is dismissed or found to be

without merit, or if the damages awarded to Contractor on its claim do not exceed Owner's offer of settlement, Contractor shall be liable to Owner and shall reimburse Owner for all attorneys' fees, costs, and expenses incurred by Owner from the date of the offer of settlement until the date of the final adjudication and resolution of Contractor's claim.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the State of Ohio.

18.08 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

18.09 *Equal Employment Opportunity and Non-Discrimination.*

A. The Contractor shall comply with, and shall require all Subcontractors of any tier to comply with, the applicable equal employment opportunity and non-discrimination statute and regulations of the State of Ohio.

The City of Canton

Date: _____

SAMPLE ONLY

SENT BY REGULAR U.S. MAIL

_____
_____
_____
_____

Re: Notice to Proceed
City of Canton – _____ Project

Dear M___. _____:

You are notified to proceed with your Work on the _____ **PROJECT** (the Project). This letter shall serve as [Name of Contractor]'s Notice to Proceed on the Project and shall be effective as of _____. The Contractor shall have its Work for the «Project_Name» scope of work, referred to herein as the "Interim Milestone Scope," substantially complete by «Date_of_Substantial_Completion». Substantial Completion is the time at which the Work has progressed to the point where the Work is sufficiently complete, in accordance with the Contract Documents, so that the Work can be utilized for the purposes for which it is intended.

Thank you.

Approved By:

_____
John Highman, Director of Public Service, City of Canton

(SAMPLE COPY)
Waste Disposal Agreement for Projects in the City of Canton

Items 1, 3 - 9 are optional and discretionary to the undersigned

THIS WASTE AGREEMENT, made this _____ day of _____ 20___ , by and between _____ (called "Contractor"), and _____ of _____ (called "Land Owner"), concerning a certain construction contract between the Contractor and _____ in the City of Canton, OH for the _____ (project), as follows:

1. MANNER OF WASTING: Land Owner grants to Contractor the exclusive right to place dirt, earth, rock, topsoil, subsurface, unsuitable and/or other excess material (called "waste material") upon the area described in the following paragraph without requirement, limit, or restriction as to depth, amount, manner, or time.
2. WASTE AREA: The property upon which Contractor is permitted to place material is commonly known as _____ (address).
3. TITLE TO WASTE AREA: The Land Owner warrants that it has title to and the right to contract for placement of waste material in said area and agrees to defend and indemnify Contractor against any claim, suit, or damage arising out of such title or right to contract.
4. ACCESS AND USE: Land Owner hereby grants Contractor the right of ingress and egress to the waste area in locations to be selected by Contractor for all purposes necessary to the complete fulfillment of this agreement, and the right of quiet enjoyment in the intended use of such area.
5. PAYMENT: Contractor agrees to pay and Land Owner agrees to accept as full and final compensation for all rights granted and covenants contained herein and all claims of every nature the sum of _____ payable _____ .
6. BASIS OF MEASUREMENTS: It is mutually agreed that measurement of the amount of materials wasted, where required, shall be made on the following basis: _____ and said measurement shall be binding upon the parties hereto for all purposes.
7. DAMAGES: Land Owner hereby waives any and all claims for damage to the waste area and to the area of ingress and egress except as specifically noted herein.
8. RELEASE: Upon receipt of final payment hereunder, and provided all terms of this agreement have been fulfilled, Land Owner hereby releases Contractor from further liability of any kind or nature hereunder.

WITNESSES:	CONTRACTOR:
_____	_____
	Authorized Signature & Title
_____	
	LANDOWNER:
_____	_____
	Signature
_____	

9. ENTIRE AGREEMENT: It is agreed that the terms and conditions of this agreement are fully covered in the foregoing, and that any oral or written statements made by either party, or agents claiming to represent either party, not set forth herein, are not binding on the parties and are not considered as part of this Agreement.
10. DISCLAIMER: The City of Canton is not a party to the here above agreement. The Contractor and Landowner shall indemnify and save harmless the City of Canton from any claim that may arise from the here above agreement. The waste material is the property of the Contractor, not the City of Canton.

Signature and Proposal Pages

Signature Page
Sugar Creek Water Treatment Plant & Wellfield Improvements

To the Director of Public Service of the City of Canton:

The undersigned, having carefully examined the complete invitation to bid, herewith proposes to furnish all the labor and materials required to complete the **Sugar Creek Water Treatment Plant & Wellfield Improvements** in accordance with the specifications on file, including any and all work and materials that may be necessary to complete the project in a proper and workmanlike manner, and in accordance with the instructions in the bid packet and under the direction of and to the satisfaction of the Director of Public Service of said City.

The bidder hereby agrees that the Director of Public Service has the right to reject any and all bids and to accept the bid(s) deemed most beneficial to the City of Canton.

The bidder hereby certifies that the undersigned _____ is the only person interested in the bid and the bidder herewith certifies that no officer or employee of the City of Canton is in any manner interested therein.

The bidder herewith encloses a _____**(BID BOND, CERTIFIED/CASHIER'S CHECK)** in the sum of $ _____ dollars made payable to the CITY OF CANTON as a guaranty that if awarded the contract for the work included in the proposal, _____ will enter into contract therefore, with sureties satisfactory to the Director of Public Service, within the prescribed time of ten (10) days from the date of service of notice of award, otherwise such bond or checks shall become the property of said City, as liquidated damages of the failure on the bidder's part to do said contract within the specified time.

The bidder acknowledges receipt of Addenda Numbers: _____.

SIGNATURE OF BIDDER: _____.

NOTE: If bidder is a corporation, set forth the legal name of the corporation, together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation. If bidder is a partnership, set forth the name of the firm, together with the signature of the partner or partners authorized to sign contracts on behalf of the partnership.

BID SCHEDULE

CITY OF CANTON, OHIO
SUGAR CREEK WATER TREATMENT PLANT
PLANT & WELLFIELD IMPROVEMENTS
CONTRACT

We (I), the above signed hereby propose to furnish the following article(s) and/or service(s) at the price(s) and terms stated subject to all instructions, conditions, specifications, and all attachments hereto. We (I) have read all attachments including the specifications and fully understand what is required.

A	B	C	D	E	F	G = E + F	H = C x G
Item	**Description**	**Quantity**	**Unit**	**Labor Unit Price**	**Material Unit Price**	**Total Unit Price (Sum of Labor and Material)**	**Item Total**
1	Bonding	1	LS				
2	Mobilization and Demobilization	1	LS				
3	Water Treatment Plant Processes, Buildings, Plumbing, HVAC, Electrical, and Instrumentation & Control Improvements that excludes Item 1, Item 2 and Items 4 thru 41	1	LS				
4	Wellfield Well Pumps, Process, Plumbing, HVAC, Electrical, and Instrumentation & Control Improvements that excludes Item 1 thru 3 and Items 5 thru 41	1	LS				

A	B	C	D	E	F	G = E + F	H = C x G
Item	**Description**	**Quantity**	**Unit**	**Labor Unit Price**	**Material Unit Price**	**Total Unit Price (Sum of Labor and Material)**	**Item Total**
5	Wellfield New Raw Water Transmission Main that excludes Item 1 thru 4 and Items 6 thru 41	1	LS				
6	Wellfield Existing Raw Water Transmission Main, Cleaning, and Solids Disposal that excludes Items 1 thru 5 and Items 7 thru 41	1	LS				
7	Dechlorination Facility Complete that excludes Items 1 thru 6 and Items 8 thru 41	1	LS				
8	Additional Reinforced Concrete Work	100	CY				
9	Additional Raw Water 12-Inch Piping between Well Building and Tee Connection on Raw Water Mains	100	LF				
10	Additional Excavation and Hauling	250	CY				
11	Additional Compacted Foundation	100	CY				
12	Additional Granular Backfill ODOT 304	100	CY				
13	Additional Structural Backfill ODOT 703.11	100	CY				

A	B	C	D	E	F	G = E + F	H = C x G
Item	**Description**	**Quantity**	**Unit**	**Labor Unit Price**	**Material Unit Price**	**Total Unit Price (Sum of Labor and Material)**	**Item Total**
14	Additional Bedding and Backfill ODOT 603	100	CY				
15	Additional LSM Bedding and Backfill ODOT 613	100	CY				
16	Pavement, Asphalt	8,000	SY				
17	Concrete Sidewalk	2,500	SF				
18	New Chain Link Fence and Entrance Gate at WTP	1,500	LF				
19	Remove & Reinstall Existing Chain Link Fence	500	LF				
20	Additional Removal and Repair of Existing Concrete	250	SF				
21	ALLOWANCE 1 - Concrete Crack Repairs and Patching	1	LS			$20,000.00	$20,000.00
22	ALLOWANCE 2 – Sanitary Sewer to Septic Tank Pipe Repair(s)	1	LS			$5,000	$5,000

A	B	C	D	E	F	G = E + F	H = C x G
Item	**Description**	**Quantity**	**Unit**	**Labor Unit Price**	**Material Unit Price**	**Total Unit Price (Sum of Labor and Material)**	**Item Total**
23	ALLOWANCE 3 - Landscaping	1	LS			$25,000.00	$25,000.00
24	ALLOWANCE 4 - Plant Signage	1	LS			$15,000.00	$15,000.00
25	ALLOWANCE 5 - Laboratory Equipment and Office Furniture	1	LS			$35,000.00	$35,000.00
26	ALLOWANCE 7 - Lagoon Residual Solids Removal, Hauling and Disposal to an Approved Landfill	1	LS			$75,000	$75,000
27	ALLOWANCE 8 – Pump Service Company (Wellfield)	1	LS			$170,000	$170,000
28	ALLOWANCE 9 – Pump Service Company (High Service Pumps)	1	LS			$375,000	$375,000
29	ALLOWANCE 10 - Additional Process Piping and Valves	1	LS			$250,000.00	$250,000.00
30	ALLOWANCE 11 - Additional Building Demolition and Renovation	1	LS			$100,000.00	$100,000.00

A	B	C	D	E	F	G = E + F	H = C x G
Item	**Description**	**Quantity**	**Unit**	**Labor Unit Price**	**Material Unit Price**	**Total Unit Price (Sum of Labor and Material)**	**Item Total**
31	ALLOWANCE 12 - Additional Demolition and Renovation for General, HVAC, and Plumbing	1	LS			$100,000.00	$100,000.00
32	ALLOWANCE 13 - Additional Demolition and Renovation for Electrical, Instrumentation and Control	1	LS			$250,000.00	$250,000.00
33	ALLOWANCE 14 - Additional SCADA Programming	1	LS			$35,000.00	$35,000.00
34	ALLOWANCE 15 - Electric Power Company	1	LS			$100,000.00	$100,000.00
35	ALLOWANCE 16 - Network Hardware	1	LS			$50,000.00	$50,000.00
36	ALTERNATE 1 – Additional time for Owner to Execute Owner-Contractor Agreement	30	DAYS				
37	ALTERNATE 2 - Canton NW WTP ATI FilterSmart Controller System	1	LS				
38	ALTERNATE 3 - Canton NE WTP ATI FilterSmart Controller System	1	LS				

A	B	C	D	E	F	G = E + F	H = C x G
Item	**Description**	**Quantity**	**Unit**	**Labor Unit Price**	**Material Unit Price**	**Total Unit Price (Sum of Labor and Material)**	**Item Total**
39	ALTERNATE 4 - 18-inch through 42-inch PCCP C301 SP-5 Finished Water Distribution Main Repair Kits	1	LS				
40	ALTERNATE 5 - Painting of Filter Pipe Gallery (Room 108, 108A, & 108B), Connected Hallways, and Stairwell E & F	1	LS				
41	ALTERNATE 6 –Roof Replacements	1	LS				

Informal Total of Base Bid Items 1 Through 35. $ _____

Informal Total of Bid Items 1 Through 41. $ _____

Respectfully submitted:

_____

Name of Contractor Address

_____

Signature Date

(Seal - if Bid is by a corporation)

Attest _____ _____

Title Phone Number

END OF SECTION