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CITY OF BATTLE CREEK, MICHIGAN
NOTICE OF INVITATION FOR BIDS
VERONA PUMPING STATION IMPROVEMENTS
IFB # 2018-072B

IFB DUE DATE and TIME: April 18, 2018 at 2:00 pm local time (office hours 8-12 and 1-5) *NOTE!* City Hall now has Security on the 1st floor. Please allow extra time to get through Security when dropping off your bid.

BID SUBMITTAL: Bids must be submitted in a sealed envelope with the IFB number, the due date/time and the bidder's name and address clearly indicated on the envelope. Bids must be in the actual possession of the Purchasing Department Room 214, City Hall, 10 N. Division Street, Battle Creek, Michigan 49014 on or prior to the exact time and date indicated above. The prevailing clock shall be www.time.gov. Late bids will not be considered. All bids will be publicly opened and read aloud at the aforementioned address. All interested parties are invited to attend.

PROJECT DESCRIPTION: The City of Battle Creek will accept sealed bids for the Verona Pumping Station Improvements project. This project consists of, the replacement of exitsting 150 HP High Service Pump #6 with a new VFD motor and pump. Yard piping reconfiguration of 30" and 24" transmission mains including cutting in two off site fire hydrants for each transmission main.

<table>
<tr><td>PRE-BID CONFERENCE:
April 10, 2018 at 2:00 pm
Department of Public Works 150 S. Kendall St Battle Creek, MI. 49037</td><td>FUNDING: This project has NO federal or state funding. All project funding is provided by the City of Battle Creek. None of the CDBG requirements are applicable for this contract.</td></tr>
<tr><td>TECHNICAL QUESTIONS OR SITE VISITATION:
Kurt Tribbett
269-966-3480</td><td>PREVAILING WAGES: Required for this project. See attached wage rates at the end of this document. Contractor shall abide by all the requirements set forth in Section 208.09, PREVAILING WAGES ON CITY PROJECTS, of the City's Administrative Code.</td></tr>
<tr><td rowspan="2">COPIES OF IFB and PLANHOLDERS LIST:
Purchasing/Engineering Division
10 N. Division Rm 214
Battle Creek, MI 49014
269-966-3390</td><td>FEE: No fee. Download only.</td></tr>
<tr><td>IFB ISSUE DATE: March 29, 2018</td></tr>
<tr><td>DOCUMENT EXAMINATION:
City of Battle Creek, Purchasing Division
Dodge Corporation in Kalamazoo, Michigan
Builders Exchange in Grand Rapids, Kalamazoo & Lansing, Michigan</td><td>ADDENDA: Each addendum will be on file in the Office of the Purchasing Agent. To the extent possible, copies will be mailed to each person registered as having received a set of bid documents. It shall be the bidder's responsibility to make inquiry as to addenda issued. All such addenda shall become a binding part of the contract.</td></tr>
<tr><td>BID BOND: Each bid must be accompanied by a certified check, cashier's check, or standard form bid bond, made payable to the City of Battle Creek, in an amount of not less than five (5%) percent of the base bid submitted. Failure of any accepted bidder to enter into a contract for the work will cause forfeit of the bid security. After contracts for the work have been signed, all bid securities will be returned.</td><td>PERFORMANCE/LABOR/MATERIALS BONDS: The accepted bidder will be required to furnish a satisfactory performance bond and labor/materials payment bond, each in an amount equal to 100% of the contract and insurance certificate upon forms acceptable to the City.</td></tr>
<tr><td colspan="2">BID VALID: Bids may be withdrawn up to the time and date of the bid opening. After the bid opening, bids may not be withdrawn for a period of ninety (90) days thereafter. The City of Battle Creek reserves the right to waive any irregularity or informality in bids, to reject any and/or all bids, in whole or in part, or to award any contract to other than the low bidder, should it be deemed in its best interest to do so.</td></tr>
</table>

SECTION I - SPECIAL INFORMATION FOR BIDDERS

1. General Contract Specification
The following sections of the General Contract Specifications BC-19-08, will be applicable for this contract General Instructions to Bidders and General Conditions of City Contracts.

2. Order Of Precedence
The plans and specifications shall be considered to be one complete document and what is called for in one shall be considered as being called for in all. In the event that there is a conflict between the parts, the following order of precedence shall govern:
Addenda to bidding documents
The Contract Drawings
The Contract Special Provisions
The Contract Special Instructions
The Contract Special Conditions
The City of Battle Creek General Contract 19-08

3. Special Conditions
The purpose of Special Conditions, Special Instructions, and Project Specifications are to change, delete, clarify or add to General Conditions, General Instructions or General Specifications found in GENERAL CONTRACT SPECIFICATIONS BC 19-08, issued 1998. Only those items addressed in Special Conditions, Special Instructions, or Project Provisions are affected. All other conditions in General Conditions, General Instructions and General Specifications still apply. Special Conditions, Special Instructions, Project Specifications, supersedes General Conditions, General Instructions and General Specifications, and in all cases shall take precedence.

4. Registration Requirements for Contractors
All bidders, including General Contractors and Specialty Contractors, shall hold or obtain such Contractors or Business Licenses as required State and Local statues.

5. Currency
Prices calculated by the bidder shall be stated in U.S. dollars.

6. Unit Price
When the Bid for the work is to be submitted on a unit price basis, unit price Bids will be accepted on all items of work set forth in the Bid, except those designated to be paid for as a lump sum. The estimated of quantities of work to be done is tabulated in the Bid and although stated with as much accuracy as possible, are approximate only and is assumed solely for the basis of calculation upon which the award of Contract shall be made. Payment to the Contractor will be made on the measurement of the work actually performed by the Contractor as specified in the Contract Documents. Unit prices will prevail in event of discrepancy and in bid tabulations.

7. Liquidated Damages
Failure of the Contractor to complete the work within the time allowed will result in damages being sustained by the City. Such damages are, and will continue to be, impracticable and extremely difficult to determine. Unless otherwise provided in the Special Conditions, the Contractor will pay to the City for the liquidated damages and not as penalty nine hundred dollars ($900.00) for each calendar day of delay in finishing the work in excess of the time specified for completion, plus any Contractor will pay the City for the liquidated damages herein before mentioned are in lieu of the actual damages arising from such breaches of this contract; which said sums the City shall have the right to deduct from any monies in its hands, otherwise due, or to become due, to said Contractor or to sue for and recover compensation or damages for non performance of this Contract at the time stipulated herein and provided for. The attention of bidders is directed to the provisions and the General Conditions of contract requiring the Contractor to pay for all excess cost of field engineering and inspection as therein defined.

8. Listing of Subcontractors
Failure to list subcontractors and major suppliers, where feasible, may be cause for rejection of the Bidder's Bid as non-responsive.

9. Non-collusion:
By signing the Offer to Contract, the bidder, by its officers and authorized agents or representatives present at the time of filing this bid, being duly sworn on their oaths say, that neither they nor any of them have in any way, directly or indirectly entered into any arrangement or agreement with any other bidder or with any public officer of such City of Battle Creek, Michigan, whereby such affidavit or affiants or either of them has paid or is to pay to such other bidder or public officer any sum of money, or has given or is to give to such other bidder or public officer anything of value whatever, or such affidavit or affiants or either of them has not directly or indirectly, entered into any arrangement or agreement with any other bidder or bidders, which tends to or does lessen or destroy free competition in the letting of the contract sought for by the attached bids, that no inducement of any form or character other than that which appears on the face of the bid will be suggested, offered, paid or delivered to any person whomsoever to influence the acceptance of the bid or awarding of the contract, nor has this bidder any agreement or

understanding of any kind whatsoever, with any person whomsoever to pay, deliver to, or share with any other person in any way or manner, any of the proceeds of the contract sought by this bid.

10. Contractor's Insurance
    a. The Contractor shall at the time of execution of this contract, file with the City the Certificate of Insurance, which shall cover all of his insurance as required herein, including evidence of payment of premiums thereon, and the policy or policies or insurance covering said City and their officers, agents and employees. Each such policy and certificate shall be satisfactory to the City. Nothing contained in these insurance requirements is to be construed as limiting the extent of the Contractor's responsibility for payment of damages resulting from his operations under this Contract. The contractor shall maintain insurances in force at all times during the term of this agreement at the minimum amounts and types as indicated.

Coverage Afforded		**Limits of Liability**
Workers' Compensation:		$ 100,000 or statutory limit
Commercial General Liability:	Bodily Injury	$1,000,000 each occurrence
(including XCU if appropriate)	Property Damage	$1,000,000 each occurrence
	or Combined Single Limit	$2,000,000
Automobile Liability:	Bodily Injury	$ 300,000 each person
	Liability	$ 500,000 each occurrence
	Property Damage	$ 500,000
	or Combined Single Limit	$ 500,000

The City of Battle Creek shall be listed as an **additional insured** on general liability coverage, and shall be provided with a Certificate of Insurance that reflects this additional insured status. A 30-day notice of cancellation or material change shall be provided to the City and so noted on the Certificate of Insurance. All certificates and notices shall be sent to City of Battle Creek, 10 N. Division, Suite 214, Battle Creek, MI 49014.

11. Vendor Evaluation: Experience with the City shall be taken into consideration when evaluating responsibility of the vendor.

12. Permits: Contractor shall secure all necessary permits to complete the work as described in this IFB. These costs shall be included in the bid price.

13. Michigan Constitutional Requirement:
    a). Notwithstanding any provision in this Contract to the contrary, and in accordance with Article I, Section 26 of the Michigan Constitution as adopted by the electorate November 7, 2006, the City and its general contractors shall not discriminate against, or grant preferential treatment to, any individual or group on the basis of race, sex, color, ethnicity, or national origin in the operation of this Contract.

    b). This section shall not prohibit any action that must be taken to establish or maintain eligibility for any federal program if ineligibility would result in a loss of federal funds in connection with this Contract, nor shall this section be interpreted as prohibiting bona fide qualifications based on sex that are reasonable necessary to the execution of this Contract.

    c). In the event of conflict between any term of this Contract and this section, the language of this section shall control.

    d) "Any party bringing a legal action or proceeding against any other party arising out of or relating to this Agreement or the transactions it contemplates shall bring the legal action or proceeding: (i) in the United States District Court for the Western District of Michigan; or (ii) in any court of the State of Michigan sitting in Calhoun County, if there is no federal subject matter jurisdiction."

SECTION II – OFFER TO CONTRACT

DATE: _____

NAME OF BIDDER: _____

BUSINESS ADDRESS: _____

_____

To: The City of Battle Creek, Michigan

The undersigned, as Bidder, declares that the only person or parties interested in this bid as principals are those named herein; that this bid is made without collusion with any person, firm or corporation; that he has carefully examined the location of the proposed work, the proposed forms of Agreement and Bonds, and the Contract Drawings and Specifications for the above designated work, all other documents referred to or mentioned in the Contract Documents, the Contract Drawings and Specifications, including Addenda issued thereto; and he proposes and agrees if this bid is accepted that he will contract with the City of Battle Creek, Michigan, in the form of the copy of the Agreement included in these Contract Documents, to provide all necessary machinery, tools, apparatus, and other means of construction, including utility and transportation services necessary to do all the work and furnish all materials and equipment specified or referred to in the Contract Documents, in the manner and time therein prescribed and according to the requirements of the City of Battle Creek, Michigan, as therein set forth and to furnish the Contractor's Bonds and Insurance, and to do all other things required of the Contractor by the Contract Documents, and that he will take in full payment therefore the sums set forth BELOW;

A bid must be made on each item with no qualifying statement(s). Bidder acknowledges that quantities are not guaranteed and final payment will be based on actual quantities determined as provided in the Contract Documents. All specific cash allowances are included in the prices set forth below and have been computed in accordance with the Contract Documents.

Acknowledgement of addenda: _____; _____; _____; _____; _____; _____

PRICE PAGE

2018-072B VERONA PUMPING STATION IMPROVEMENTS

ITEMS NO.	DESCRIPTION	UNITS	EST. QTY.	UNIT PRICE	ITEM TOTAL
1	Mobilization & Gen Conds	1	LSUM		
2	Traffic Control	1	LSUM		
3	Erosion Control	1	LSUM		
4	Pump Removal	1	LSUM		
5	Pump Base Modifications	1	LSUM		
6	High Service Pump 6	1	LSUM		
7	Electrical Improvements	1	LSUM		
8	HMA Pavement Removal	280	SqYd		
9	8" Agg Base	280	SqYd		
10	MDOT 13A HMA	280	SqYd		
11	Fire Hydrant Assembly	2	EA		
12	Cut & Cap Ex. 20" WM	1	EA		
13	Cut & Cap Ex. 24" WM	2	EA		
14	Cut & Cap Ex. 30" WM	2	EA		
15	24" DIP WM	80	LF		
16	30" DIP WM	93	LF		
17	24" Bend 11.25*	1	EA		
18	20" Bend 45*	1	EA		
19	24" Bend 45*	2	EA		
20	30" Bend 45*	2	EA		

21	24"x6" Tee	1	EA		
22	30"x8" Tee	1	EA		
23	8" x 6" Reducer	1	EA		
24	20" WM Connection	1	EA		
25	24" WM Connection	1	EA		
26	30" WM Connection	2	EA		
27	24" x 20" Reducer	2	EA		
28	30" x 24" Reducer	2	EA		
29	24" WM Butterfly Valve	2	EA		
30	30" WM Butterfly Valve	1	EA		
31	Ex. WM Struct. Removal	1	EA		

TOTAL BASE BID $_____

BID CONDITIONS

It is expressly understood and agreed that the total base bid as reflected on the attached Bidding Schedule is the basis for establishing the amount of the bid security on this bid and that this total base bid is not to be construed a Lump Sum Bid. It is further understood that quantities in the Bidding Schedule for unit price items are approximate only, and that payment of a contract will be made only on the actual quantities or work completed in place, measured on the basis defined in the General Provisions, Contract Specifications or other Contract Documents.

The undersigned has carefully checked the attached Bidding Schedule against the Contract Drawings and Specifications and other Contract Documents before preparing this Bid and accepts the said quantities to be substantially correct, both as to classification and amount, and as correctly listing the complete work to be done in accordance with the Contract Drawings, Specifications and other Contract Documents.

BID SECURITY

Accompanying this bid is a _____ in the amount of five percent (5%) or _____ Dollars ($_____). The total amount of bid security is based on the total base bid of this Bid.

COMPLETION

This project has two components; yard piping reconfiguration shall begin upon notice to proceed and shall be completed by and June 27, 2018 before heavy water consumption begins. The replacement of High Service Pump #6 shall be completed by Oct 1, 2018.

LIQUIDATED DAMAGES

Liquidated damages of $900.00 per calendar day will be assessed for failure to meet any deadline, as noted in the Project Specifications.

BIDDER'S SIGNATURE: Complete the applicable paragraph below.

I certify, under penalty of perjury, that I have the legal authorization to bind the firm hereunder, and that our firm is not debarred from doing business under the Federal Excluded Parties List System (epls.gov).

I, the Contractor or Contractor's legally authorized signer, further certify compliance with the City of Battle Creek Ordinance Chapter 214, Discrimination Prohibited. I further acknowledge and agree that the Contractor's violation of Chapter 214 shall be a material breach of this contract. In addition, Contractor acknowledges and agrees that it shall be liable for any costs or expenses incurred by the City in obtaining from other sources, the work and services to be rendered or performed or the goods or properties to be furnished or delivered to the City under the contract as a result of a material breach in the Contract for violations of Chapter 214.

(a) Corporation
The bidder is a corporation organized and existing under the State of _____, which operates under the legal name of _____, and the full names of its officers are as follows:
President: _____
Secretary: _____
Treasurer: _____
Manager: _____

(b) Co-Partnership
The bidder is a co-partnership consisting of individual partners whose full names are as follows:

_____ _____
_____ _____
_____ _____
_____ _____

(c) Individual
The bidder is an individual whose full name is _____ and, if operating under a trade name, said trade name is _____.
NAME: _____
ADDRESS: _____
CITY & STATE: _____

THIS BID OFFERED BY:

SIGNATURE: _____

NAME: _____

TITLE: _____

PHONE: _____

FAX: _____

EMAIL: _____

(SEAL)
Subscribed and sworn to before me this ____ day of _____, 20__.

_____
Notary Public

County of _____

Commission Expires: _____

SECTION III - CONTRACTOR'S BID FORMS

THESE FORMS MUST BE RETURNED WITH THE BID

TABLE OF CONTENTS

CONTRACTOR'S BID BOND

CORPORATION CERTIFICATE

SUBCONTRACTOR AND DBE FORM

STATEMENT OF EXPERIENCE OF BIDDERS

CONTRACTOR'S BID BOND

KNOW ALL MEN BY THESE PRESENTS, That we, _____, (hereinafter called the "Principal"), and _____(hereinafter called the "Principal"), and _____ hereinafter called the "Surety"), a corporation chartered and existing under the laws of the State of _____, with its principal offices in the City of _____ and authorized to do business in the State of Michigan, are held and firmly bound unto the City of Battle Creek (hereinafter called the "Owner"), in the full and just sum of _____ _____ Dollars ($_____) good and lawful money of the United States of America, to be paid upon demand of the Owner, to which payment well and truly to be made, the Principal and Surety bind themselves, their heirs, executors, administrators, and assigns, jointly and severally and firmly by these presents.

WHEREAS, the Principal is about to submit, or has submitted to the Owner, a Bid for furnishing all labor, materials, equipment and incidentals necessary to complete this contract.

WHEREAS, the Principal desires to file this bond in accordance with law, in lieu of a certified bidder's check otherwise required to accompany this Bid.

NOW, THEREFORE: The conditions of this obligation are such that if the Bid be accepted, the Principal shall, within ten (10) days after the date of receipt of a written notice of award of contract, execute a contract in accordance with the Bid and upon the terms, conditions and price(s) set forth therein, of the form and manner required by the Owner, and execute a sufficient and satisfactory contract performance bond payable to the Owner, and in an amount of One Hundred Percent (100%) of the total contract price in the form and with security satisfactory to said Owner, then this obligation to be void; otherwise to be and remain in full force and virtue in law; and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid Owner, upon demand, the amount hereof in good and lawful money of the United States of America, not as a penalty but as liquidated damages.

IN TESTIMONY THEREOF, the Principal and Surety have caused these presents to be duly signed and sealed this _____ day of _____, 20___.

_____
Principal

By:_____
(Seal)

_____
Surety

By:_____
(Seal)

Countersigned:_____

CERTIFICATE TO BE EXECUTED

IF

CONTRACTOR IS A CORPORATION

I, _____, certify that I am the _____ of the Corporation named as Contractor hereinabove; that _____ who signed the foregoing Agreement on behalf of the Contractor was then the _____ of said Corporation; that said Agreement was duly signed for and in behalf of said Corporation by authority of its governing body and is within the scope of its corporate powers.

_____

(Corporate Seal)

SUBCONTRACTOR AND DBE FORM – submit with bid

I. YOUR FIRM'S BACKGROUND:

Is your firm an MBE (at least 51% minority ownership)? _____YES _____NO

Is your firm a WBE (at least 51% woman ownership)? _____YES _____NO

Are you subcontracting any part of this project? _____YES _____NO

II. SUBCONTRACTING INFORMATION:

If subcontracting any part of the project, the bidder/contractor expressly agrees that:

(1) If awarded a contract as a result of this bid, the major subcontractors used in the prosecution of the work will be those listed below, and
(2) The following list includes all subcontractors who will perform work representing approximately five percent (5%) or more of the Total Base Bid.
(3) The Bidder represents that the subcontractors listed below are financially responsible and are qualified to do the work required.

SUBCONTRACTOR NAME	City/State	Trade or Commodity	MBE	WBE	Approximate dollar value
			Y / N	Y / N	$
			Y / N	Y / N	$
			Y / N	Y / N	$
			Y / N	Y / N	$
			Y / N	Y / N	$
			Y / N	Y / N	$
			Y / N	Y / N	$
			Y / N	Y / N	$

III. DBE RECRUITMENT ACTIVITY LOG:

List the MBE's and WBE's that were approached about being a subcontractor for this job, but who are NOT listed above as a subcontractor.

NAME OF FIRM *APPROACHED*, BUT NOT USED ON THIS PROJECT	City/State	Trade or Commodity	MBE	WBE	Reason not used on this project
			Y / N	Y / N	
			Y / N	Y / N	
			Y / N	Y / N	
			Y / N	Y / N	

STATEMENT OF EXPERIENCE OF BIDDER

The Bidder shall state below the work of similar magnitude or character that he has done, and shall give references that will enable the City of Battle Creek to judge his experience, skill and business standing and of his ability to conduct the work as completely and as rapidly as required under the terms of this contract.

PROJECT AND LOCATION ***REFERENCES (include name and phone number)***

(1) _____

_____

(2) _____

_____

(3) _____

_____

(4) _____

_____

(5) _____

_____

(6) _____

_____

(7) _____

_____

(8) _____

_____

(9) _____

_____

SECTION IV - CONTRACTOR'S CONTRACT FORMS

THESE FORMS WILL BE REQUIRED FOR AWARD

CONTRACT FORM

PERFORMANCE BOND

LABOR AND MATERIAL BOND

CONTRACT FORM
CONTRACT NO. 2018-072B
Verona Pumping Station Improvements

THIS AGREEMENT, made and entered into this _____ day of _____, 2018, by and between _____ hereinafter called the "Contractor" and the City of Battle Creek, hereinafter called the "Owner."

WITNESSETH: In consideration for the mutual covenants hereinafter stated, the parties agree for themselves, their personal representatives, successors, assigns as follows:

I. The Contractor promises and agrees:

A. To furnish all materials, construction water, equipment, tools, dewatering devices, skill and labor of every description necessary or reasonable incidental to carrying forth and completing in good, firm, substantial and workmanlike manner, the work specified, in strict conformity with the true intent of the NOTICE TO BIDDERS, SPECIAL INSTRUCTIONS, GENERAL INSTRUCTIONS, BID, SPECIAL CONDITIONS, GENERAL CONDITIONS, AGREEMENT, BONDS, GENERAL SPECIFICATIONS, and Project Specifications, and other contract documents and addenda thereto, which are hereby made a part hereof as fully and to the same effect as though they had been set forth at length herein.

B. To commence work under this contract on or before a date to be specified by the owner in a written Notice to Proceed and complete the project by the date specified in Bid.

C. Requirements for a specific trade or contract will generally be described in that portion of the specifications or drawings related to that trade or contract. Such requirements may, however, be described in other sections of the Contract Documents. The Contractor will be held responsible for having carefully examined all drawings and read all requirements of the specifications and all Contract Documents to avoid omissions or duplications and to insure a complete job.

D. The Contractor must be fully informed about conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his contract.

E. Any claim by the Contractor of an inability to meet any requirement set forth in the Contract Documents, or that any requirement of these documents is impractical or unreasonable, will not be recognized, unless the claim was made at the time his Bid was submitted, and specific provision is made for such claim in the Agreement between Owner and Contractor (Bid and Agreement).

F. Warranty: Contractor shall remove and replace at no additional cost to the City any defects in workmanship or materials that may be apparent or may develop within a period of one (1) year from the date of final acceptance.

G. NON-DISCRIMINATION CLAUSE: The bidder agrees not to discriminate against any employee or applicant for employment, to be employed in the performance of such contract with respect to hire tenure, terms, conditions or privileges, of employment, or any matter directly or indirectly related to employment because of his or her actual or perceived race, color, religion, national origin, sex, age, height, weight, marital status, physical or mental disability, family status, sexual orientation, or gender identity. Breach of this covenant may be regarded as a material breach of the contract as provided for in Act 220 and Act 453 of the Public Acts of 1976, as amended, entitled "Michigan Handicapper's Civil Rights Act" and/or the "Michigan Elliott Larson Civil Rights Act" and/or City of Battle Creek Chapter 214 "Discrimination Prohibited" Ordinance. The bidder further agrees to require similar provisions from any subcontractors, or suppliers. The bidder agrees to comply with the Executive Order 11246 of September 24, 1965, entitled "Equal Employment Opportunity," as amended by Executive Order 11375 of October 13, 1967, as supplemented in Department of Labor regulations (41 CFR, Chapter 60).

II. The Owner promises and agrees:

A. To pay the Contractor for said work when completed in accordance with the provisions of these contract documents, and for the contract sum of:

dollars ($).

Payment for work is subject to additions provided therein and for the authorized work complete in place and accepted by the Owner or its authorized representatives.

III. It is further understood and agreed between the parties hereto as follows:

A. The said work is to be done in accordance with the laws of the State of Michigan to the entire satisfaction and approval of the Owner or its duly authorized representatives.

B. The decision of said Owner's authorized representative upon any questions connected with the execution of this Agreement or any failure or delay in the prosecution of the work by said Contractor shall be final and conclusive.

C. If, at any time after the execution of the Agreement and the Bond for its faithful performance, the Owner shall deem the surety or sureties then upon said bond to be unsatisfactory or, if, for any reason said bond shall cease to be adequate security for the performance of the work, the Contractor shall, at his expense, within fifteen (15) calendar days after receipt of written notice from the Owner to do so, furnish an additional bond or bonds in such form and amount and with such surety or sureties as shall be satisfactory to the Owner. In such event, no further payment to the Contractor shall be deemed to be due under this Agreement until such new or additional security for the faithful performance of the work shall be furnished in a manner and form satisfactory to the Owner.

D. VENUE: Any party bringing a legal action or proceeding against any other party arising out of or relating to this Agreement or the transactions it contemplates shall bring the legal action or proceeding:

(i) in the United States District Court for the Western District of Michigan; or

(ii) in any court of the State of Michigan sitting in Calhoun County, if there is no federal subject matter jurisdiction.

E. GOVERNING LAW: This agreement shall be enforced under the laws of the State of Michigan. Contractor must comply with all applicable federal, state, county, and City laws, ordinances, and regulations. Contractor shall ensure payment of all taxes, licenses, permits, and other expenses of any nature associated with the provision of services herein. Contractor shall maintain in current status all Federal, State and Local licenses and permits required for the operation of the business conducted by the Contractor.

IN WITNESS WHEREOF, the said parties have hereunto set their hands and affixed their seals, the day and year first above written.

STATE OF MICHIGAN)
) ss
COUNTY OF CALHOUN)

SIGNED, SEALED, AND
EXECUTED BY CONTRACTOR:

I certify, under penalty of perjury, that I have the legal authorization to bind the firm hereunder, and that our firm is not debarred from doing business under the Federal Excluded Parties List System (epls.gov):

In the Presence of:

_____

By:_____

_____
Notary Public

Title:_____

SIGNED, SEALED, & EXECUTED
BY CITY OF BATTLE CREEK

CONTRACT FORM APPROVED BY:

_____
City Attorney

_____
City Manager

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that _____, as Principal, and_____ _____, as Surety, are held and firmly bound unto the City of Battle Creek in the full and just sum of _____Dollars ($_____) lawful money of the United States of America for the payment of which sum of money well and truly to be made, we bind ourselves, heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract dated the_____ day of _____, 20_____ for the _____ complete, as described in the foregoing Bid and Agreement.

NOW THE CONDITIONS OF THIS OBLIGATION ARE SUCH, that if the said Principal shall in all respects well and truly keep and perform the said contract, and shall pay all sums of money due or to become due, for any labor, materials, apparatus, fixtures or equipment furnished for the purpose of constructing the work provided in said contract, and shall defend, indemnify and save harmless said City of Battle Creek against any liens, encumbrances, damages, claims, demands, expenses, costs and charges of every kind except as otherwise provided in said specifications and other Contract Documents arising out of or in relation to the performance of said work and the provisions of said contract, and shall remove and replace any defects in workmanship or materials which may be apparent or may develop within a period of one (1) year from the date of final acceptance, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

And the said Surety, for value received, hereby stipulates and agreed that no change, extension of time, alteration or addition to the terms of the contract or to work to be performed thereunder or the specifications accompanying the same shall in any wise affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Agreement or to the work or to the specifications.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this _____ day of _____, 20__.

PRINCIPAL ATTEST:

_____
Principal Business Name

_____
Address

_____
City, State, Zip

_____
Principal Secretary Signature & Seal

_____
Principal Secretary Printed Name

_____
Witness of Principal

SURETY ATTEST:

_____
Surety Business Name

_____
Address

_____
City, State, Zip

BY:_____
Attorney-in-Fact Signature & Seal

_____
Attorney-in-Fact Printed Name

LABOR AND MATERIALS BOND

KNOW ALL MEN BY THESE PRESENT, that we, the undersigned, _____, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, having its principal office at _____, hereinafter called the "Surety," are held and firmly bound unto the City of Battle Creek, hereinafter called the "Owner," for use of any and every person, co-partnership, association or corporation interested in the full and just sum of _____Dollars ($_____), lawful money of the United States of America, to be paid to the said obligees or its or their assigns, to which payment well and truly to be made we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents. Sealed with our respective seals and dated this ____ day of _____, 20___.

WHEREAS, the above bounded _____, Principal, has entered into a contract with the City of Battle Creek.

Dated the _____ day of _____, 20___, for the _____.

NOW, THEREFORE, THE CONDITION OF THIS CONDITION IS SUCH, that if the above bounded Principal shall and will promptly pay or cause to be paid all sums of money which may be due any person, co-partnership, association or corporation for all material furnished and labor supplied or performed in the prosecution of the work, whether or not the said material or labor enter into and become component parts of the work or improvement contemplated, then this obligation to be void; otherwise to remain in full force and effect.

The Principal and Surety further jointly and severally agree with the obligee herein that every person, co-partnership, association or corporation who, whether as subcontractor or otherwise, has furnished material or supplied or performed labor in the prosecution of the work as above provided and who has not been paid therefore may sue in assumption on this bond in the name of the Owner for his, their, or its use, prosecute the same to final judgment for such sum or sums as may be justly due him, them, or it, and have execution thereon, provided, however, that the Owner shall not be liable for payment of any costs or expenses of any such suit.

IT IS FURTHER AGREED, that any alterations which may be made in the terms of the contract or in the work to be done or materials to be furnished or labor to be supplied or performed under it or the giving by the Owner or any extension of time for the performance of the contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and Surety or Sureties or either or any of them their heirs, executors, administrators, successors or assigns, from their liability hereunder, notice to the Surety or Sureties of any such alteration, extension or forbearance being hereby waived.

IN WITNESS WHEREOF, the said Principal and Surety have duly executed this bond under the seal and day and year first above written.

ATTEST:

_____
Principal

_____
(Seal)

BY:_____

_____
Surety

ATTEST

BY:_____
Attorney-in-Fact

_____

(SEAL)

SECTION V - SPECIAL CONDITIONS

1. Supplementary Definitions: The following additional definitions supplement the definitions included in the General Contract Specifications BC 19-08, Paragraph I-1 of the General Conditions of Contract:

(a) "Owner" or "City of Battle Creek" or "City" shall mean the City of Battle Creek, MI, acting through the City Commission or any other board official, or officials to which or whom the power belonging to the Commission shall, by virtue of any act or acts thereafter passed are held to appertain.

(b) "Engineer" shall mean the City Engineer, or other persons designated by the City acting directly or through authorized agents.

(c) "Contract Drawings" The drawings applicable to the work to be performed under this contract and that are referred to in this documents as the plans or as the contract drawings.

SECTION VI – PREVAILING WAGES

General Decision Number: MI180053 01/05/2018 MI53

Superseded General Decision Number: MI20170053

State: Michigan

Construction Type: Heavy

County: Calhoun County in Michigan.

Heavy, Includes Water, Sewer Lines and Excavation (Excludes Hazardous Waste Removal; Coal, Oil, Gas, Duct and other similar Pipeline Construction)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 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 calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number Publication Date
0 01/05/2018

CARP0525-006 06/01/2017

	Rates	Fringes
CARPENTER, Includes Form Work	$ 22.15	19.30

ELEC0445-007 05/29/2017

	Rates	Fringes
ELECTRICIAN	$ 31.00	19.38

ENGI0325-013 09/01/2017

POWER EQUIPMENT OPERATORS: Underground Construction (Including Sewer)

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 30.32	23.35
GROUP 2	$ 25.43	23.35
GROUP 3	$ 24.93	23.35
GROUP 4	$ 24.65	23.35

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Backhoe/ Excavator, Boring Machine, Bulldozer, Grader/ Blade, Loader, Roller, Scraper, Trencher (over 8 ft. digging capacity)

GROUP 2: Trencher (8-ft digging capacity and smaller)

GROUP 3: Boom Truck (non-swinging, non-powered type boom)

GROUP 4:: Broom/ Sweeper, Fork Truck, Tractor, Bobcat/ Skid Steer /Skid Loader

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ENGI0326-005 06/01/2017

EXCLUDES UNDERGROUND CONSTRUCTION

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1	$ 31.63	23.30
GROUP 2	$ 29.92	23.30
GROUP 3	$ 29.92	23.30
GROUP 4	$ 24.06	23.30

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

Swing Boom Truck Operator over 12 tons-$.50 per hour

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Backhoe/Excavator; Boring Machine; Bulldozer; Grader/Blade; Loader; Roller; Scraper; Tractor; Trencher

GROUP 2: Bobcat/Skid Loader; Broom/Sweeper; Fork Truck (over 20' lift)

GROUP 3: Boom truck (non-swinging)

GROUP 4: Fork Truck (20' lift and under for masonry work)

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* IRON0340-004 06/19/2017

	Rates	Fringes
IRONWORKER, STRUCTURAL AND REINFORCING	$ 24.43	24.67

LABO0334-007 09/01/2014

SCOPE OF WORK:
OPEN CUT CONSTRUCTION: Excavation of earth and sewer, utilities, and improvements, including underground piping/conduit (including inspection, cleaning, restoration, and relining)

	Rates	Fringes
LABORER		
(1) Common or General	$ 19.65	12.75
(2) Mason Tender-Cement/Concrete	$ 19.78	12.75
(4) Grade Checker	$ 19.96	12.75
(5) Pipelayer	$ 20.08	12.75
(7) Landscaper	$ 15.64	12.75

LABO0334-012 06/01/2017

EXCLUDES OPEN CUT CONSTRUCTION

Rates Fringes

Landscape Laborer
GROUP 1.....$ 20.32 6.80
GROUP 2.....$ 18.32 6.80

LANDSCAPE LABORER CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel
equipment operator, lawn sprinkler installer and skidsteer
(or equivalent)

GROUP 2: Landscape laborer: small power tool operator,
material mover, truck driver and lawn sprinkler installer
tender

LABO0355-010 06/01/2016

EXCLUDES OPEN CUT CONSTRUCTION

Rates Fringes

LABORER
Common or General; Grade Checker; Mason Tender - Cement/Concrete.....$ 20.09 12.85
Pipelayer.....$ 20.34 12.85

PAIN0312-014 06/12/2014

Rates Fringes

PAINTER
Brush & Roller.....$ 21.75 11.94
Spray.....$ 22.75 11.94

PLAS0016-020 04/01/2014

Rates Fringes

CEMENT MASON/CONCRETE FINISHER...$ 22.31 12.83

PLUM0333-007 06/01/2017

Rates Fringes

PLUMBER.....$ 35.89 21.13

TEAM0007-011 06/01/2017

Rates Fringes

TRUCK DRIVER
Lowboy/Semi-Trailer Truck...$ 25.05 .50 + a+b
Tractor Haul Truck.....$ 24.80 .50 + a+b

FOOTNOTE:
a. $455.00 per week.
b. $64.40 daily.

SUMI2010-051 11/09/2010

Rates Fringes

OPERATOR: Crane.....$ 25.26 5.00

TRUCK DRIVER: Dump Truck.....$ 18.00 6.43

TRUCK DRIVER: Off the Road Truck.....$ 20.82 3.69

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

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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 www.dol.gov/whd/govcontracts.

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
Regional Office for the area in which the survey was conducted
because those Regional Offices have 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 DECISION

SECTION VII – SPECIFICATIONS (ATTACHMENT)

SECTION 01010

DEFINITION OF CONTRACT ITEMS

PART 1 GENERAL

1.01 FOREWORD

A. This Section describes the various Contract Items listed in the Bid.

1.02 WORK INCLUDED

A. Under each Item the Contractor shall furnish all labor, materials, tools, plant equipment, supplies, maintenance of equipment, heating, lighting and power, insurance and bonds, coordination, and all work and in accordance with the Specifications Parts A, B, and Divisions 1 through 16 of Part C and necessary to complete the work in accordance with the obvious or expressed intent of the Contract Documents.

1.03 WORKMANSHIP AND MATERIALS

A. The quality of workmanship and materials entering into any and all of the Items and the work included shall conform to pertinent sections, paragraphs, sentences, and clauses, both directly and indirectly applicable thereto, contained in the Contract Documents, whether or not direct reference to such occurs under each Item in this Section.

1.04 PAYMENT

A. The lump sum and unit prices stated in the Bid shall be payment in full for the completion of all work specified and described or required to be included in the Contract, complete, and ready for use.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

None.

PART 4 SPECIAL PROVISIONS

4.01 CONTRACT ITEMS

A. The contract items are defined on the following pages.

ITEM 1
MOBILIZATION & GENERAL CONDITIONS

1.01 DESCRIPTION

A. This Item is intended to pay non-recurring cost to the Contractor not recovered under other pay Items of the Contract.

B. This Item shall include, but not be limited to, the cost for moving equipment in and out, performance and payment bonds, insurance, permits, utility connection cost, and other expenses associated with preparation for construction in accordance with the requirements of the Contract Documents.

1.02 WORK NOT INCLUDED

A. Any work specifically included under other Bid Items.

1.03 DEFINITION OF ITEM

A. Item 1 - Includes Mobilization.

1.04 PAYMENT

A. The lump sum stated in the Bid shall be full compensation for all work required under Item 1 as required in the general conditions of the contract.

ITEM 2
TRAFFIC CONTROL

2.01 DESCRIPTION

A. Under this Item, the Contractor shall mobilize all equipment and materials necessary to complete the project as described in the specifications and plans. Traffic Control plan shall be developed by the Contractor and shall be approved by the Owner prior to commencement of work in areas where traffic control is required.

2.02 DEFINITION OF ITEMS

A. Item 2 - Includes all traffic control devices and labor to protect the jobsite during construction in Bailey Park.

2.03 PAYMENT

A. The unit price stated in the Bid shall be full compensation for traffic control as specified and required.

ITEM 3
EROSION CONTROL

3.01 DESCRIPTION

A. Under this Item, the Contractor shall obtain and follow the general pollution control measures provided in the specifications and plans. Included are soil erosion and control measures, dechlorination of water from flushing mains, dust control, etc.

3.02 DEFINITION OF ITEMS

A. Item 3 - Includes Erosion Control, including all material and labor necessary to implement required storm water pollution BMPs and disposal of chlorinated water from flushing.

3.03 WORK NOT INCLUDED

A. Soil Erosion and Sedimentation Control Permit from the Calhoun County Road Department, which is to be included in Item 1.

3.04 PAYMENT

A. The lump sum stated in the Bid shall be full compensation for pollution control as specified and required.

ITEMS 4 THROUGH 7
VERONA HSP 6 REPLACEMENT ITEMS

4.01 DESCRIPTION

A. Under these Items, the Contractor shall perform all work to remove, replace, and place into service High Service Pump 6.

B. All conduit, wiring, terminations, hangers, supports, sawing and coring, testing, startup, certification, and training required by the spec shall be incidental to the related work item.

C. The delivery of salvaged materials and equipment, including but not limited to, pump bowls column pipe, pump head, valve, pneumatic operator, electrical panels and/or electrical components to the Owner's designated location shall be included under these Items.

4.02 WORK NOT INCLUDED

A. Water piping replacement located outside of the Verona Pumping Station building.

4.03 DEFINITION OF ITEMS

A. Item 4 - Includes removal of the existing High Service Pump 6, removal of the existing butterfly valve and pneumatic operator.

B. Item 5 - Includes any modifications to the existing concrete curb to support the installation of the replacement pump.

C. Item 6 – Includes procurement and installation of the new High Service Pump 6 including the reducer (from pump flange to new BFV-18, installation of Air/Vacuum Release Valve, and replacement of butterfly valve with motor operator (BFV-18). Additionally, all startup, certification, and training for the pump and valves shall be incidental to this bid item.

D. Item 7 – Includes procurement and installation of all electrical improvements, conduit, wiring, transformer, variable frequency drive, support devices, and appurtenances. All testing, startup, and integration of electrical and control items shall be incidental to this item.

4.04 MEASUREMENT

A. The work to be paid for under Items 4-7 shall be lump sum in accordance with the specifications and drawings

4.05 PAYMENT

A. The unit price stated in the Bid for Items 4 through 7 shall be full compensation for lump sum specified in the bid, as a percentage of work completed at the time of payment application.

ITEMS 8 THROUGH 10
PAVEMENT

8.01 DESCRIPTION

A. Under these Items, the Contractor shall construct pavement base and surface courses to replace pavement removed for pipe line construction as scheduled, shown on the Drawings and specified herein.

B. Testing of compaction of the base aggregate and HMA pavement shall be incidental to these payment items.

8.02 WORK NOT INCLUDED

A. Pavement replacement required beyond specified pay limits for construction of fire hydrants.

B. Excavation of subgrade soils for installation of piping which included in the Fire Hydrant Assembly Pay Item.

8.03 DEFINITION OF ITEMS

A. Item 8 - Includes removal of existing asphalt pavement and any existing aggregate base for connection to the existing WM and installation of 6" WM piping under the roadway.

B. Item 9 - Includes installation of 8-inches of aggregate base per section 02600.

C. Item 10 - Includes two (2), two-inch (2") courses of MDOT 13A HMA.

8.04 MEASUREMENT

A. Quantities to be paid for under these Items shall be the actual quantity constructed, measured in place within the limits as defined below, and scheduled on the Drawings, unless otherwise authorized by the Engineer; in which case, measurement will be made to the authorized limits. When uniform courses are specified, the volume to be paid for shall not exceed the quantity calculated from plan lines and dimensions. Bituminous materials will be measured in gallons at 60 degrees F applied at the specified rates and within the pay limits.

B. Pay Limits:

1. Depth - As specified, scheduled, or directed by the Engineer. To differentiate from special backfill material, Aggregate Base under Item 8 shall only be measured for the thickness shown on the Drawings specified or directed by the Engineer.

2. Length - The actual length measured.

3. Width:

a. Except as otherwise scheduled on the Drawings, the width of replacement over pipe trenches shall not exceed the nominal diameter of the pipe plus 2-1/2 feet on each side for trench depths of 16 feet and less; and 4 feet on each side for trench depths greater than 16 feet. No additional width will be allowed for precast manholes or manhole chamber construction.

b. Trench depth as used herein shall mean the distance from the original surface of the pavement to the invert grade of the main line pipe.

8.05 PAYMENT

A. The unit prices stated in the Bid for Items 8, 9, and 10 shall be full compensation for each square yard of pavement excavated, aggregate base placed and compacted, or pavement placed within the prescribed limits as specified, so measured.

ITEM 11
FIRE HYDRANT ASSEMBLY

11.01 DESCRIPTION

A. Under this Item, the Contractor shall furnish and perform all work necessary for the installation of the fire hydrant assemblies, shown on the Drawings and specified, in conformance with relevant sections of the Specifications.

B. This Item shall include all work to install the fire hydrant assemblies, including but not limited to the following: excavation; saw-cutting; hauling excess spoil material from project site; backfill; compaction; bedding; pipe materials; fittings; connections to water main fittings/reducers installed in other items, maintenance and removal of temporary access to the work area; and related work such as performing material testing.

C. Installation of all 6-inch DIP water piping leading from the connection point to the hydrant assembly.

11.02 WORK NOT INCLUDED

A. Pavement removal, aggregate road base, and pavement replacement within Contract limits is included for payment under other Items.

B. Installation of tees and reducers on the water transmission mains is included in other Items.

11.03 DEFINITION OF ITEMS

A. Item 11a- Hydrant Assembly.

11.04 MEASUREMENT

A. The quantity to be paid under Items shall be the measured quantity of each fire hydrant assembly completed as specified, shown on the drawings and so measured.

11.05 PAYMENT

A. The unit price stated in the Bid for Item 11 shall be full compensation for each hydrant assembly so measured, as specified and required.

ITEMS 12 THROUGH 30
WATERMAIN ITEMS

12.01 DESCRIPTION

A. Under these Items, the Contractor shall furnish and perform all work necessary for the installation of the water main piping, fittings, valves, and appurtenances as scheduled, shown on the Drawings and specified, in conformance with relevant sections of the Specifications.

B. These Items shall include all work to install the waterlines, including but not limited to the following: excavation; saw-cutting, backfill; compaction; bedding; pipe materials; fittings; maintenance of trenches; connections to existing water mains; abandonment of existing watermains, valves, and related work and materials such as blow offs to perform disinfection, flushing, performing pressure and bacteriological tests as shown on the Drawings and specified in conformance with relevant Sections of the Specifications.

C. These Items shall also include all work under the Contract unless specifically included for payment under other Items.

D. Connections of new water lines to: new and existing water lines shall be included under these Items, unless specifically included under other items. Temporary supporting of existing utilities, locating of existing utilities, exploratory excavation and backfill required by the utility owner for existing utilities encountered during construction is included under these Items.

E. The removal of existing water mains, as required to complete the work, including existing fittings, valves, backfill, bedding, structures and other associated appurtenances shall be included under these items. The removals noted are included under this Item incidental to the water line construction.

F. These Items shall include all water main fittings, accessories and appurtenances not included in other pay items. Fittings, including those not shown on the plans required to avoid existing utilities shall be included under these Items.

G. All work necessary to abandon designated existing water lines is included under these Items.

H. All repairs of existing utilities damaged, as a result of construction, are included under these Items.

I. Restoration of landscape surface improvements including seeding, mulching, and fertilizing all disturbed lawn areas shall be included under these Items, unless specifically included under other items.

12.02 WORK NOT INCLUDED

A. Pavement replacement within the Contract limits is included under other Items.

B. Hydrant assemblies including associated 6-inch water main piping are included under other items.

12.03 DEFINITION OF ITEMS

A. Item 12 - Includes cutting, removal of piping, and plugging the abandoned in place 20-inch water main.

B. Item 13 - Includes cutting, removal of piping, and plugging the abandoned in place 24-inch water main.

C. Item 14 - Includes cutting, removal of piping, and plugging the abandoned in place 30-inch water main.

D. Item 15 – Includes installation of new 24-inch DIP watermain piping, including joint restraint at all joints.

E. Item 16 – Includes installation of new 30-inch DIP watermain piping, including joint restraint at all joints.

F. Item 17 - Includes 24-inch, 11.25° bend fitting.

G. Item 18 – Includes 20-inch 45° bend fitting.

H. Item 19 – Includes 24-inch 45° bend fitting.

I. Item 20 – Includes 30-inch 45° bend fitting.

J. Item 21 – Includes 24-inch x 6-inch tee fitting.

K. Item 22 – Includes 30-inch x 8-inch tee fitting.

L. Item 23 – Includes 8-inch x 6-inch reducer fitting.

M. Item 24 – includes connection to the existing 20-inch watermain.

N. Item 25 – Includes connection to the existing 24-inch watermain.

O. Item 26 – Includes connection to the existing to the existing 30-inch watermain.

P. Item 27 – Incudes 24-inch x 20-inch reducer fitting.

Q. Item 28 – Includes 30-inch x 24-inch reducer fitting.

R. Item 29 – Includes 24-inch butterfly valve with valve box.

S. Item 30 – Includes 30-inch butterfly valve with valve box.

12.04 MEASUREMENT

A. The quantities to be paid under Items 12 through 14 shall be the full compensation for each water line plugged, including adequate removal of existing piping to allow for installation of new items, furnished and installed in accordance with the Specifications and Drawings

B. The quantities to be paid for under Item 15 and 16 shall be the horizontal length of pipe installed and completed including flushing, restoration, testing, and sampling

C. The quantities to be paid for under Items 17 through 23 and 27 through 30 shall be measured by each item installed and completed including flushing, restoration, testing, and sampling.

D. The quantities to be paid under Items 24 through 26 shall be the full compensation for each water Line connection to existing water Line furnished and installed in accordance with the Specifications and Drawings.

12.05 PAYMENT

A. The unit price stated in the Bid for Items 12 through 14 and 17 through 30 through 1d shall be full compensation for each item, furnished and installed as specified so measured.

B. The unit price stated in the Bid for Item 15 and 16 shall be full compensation for each lineal foot of water main piping furnished and installed, so measured, as specified and required.

C. Six dollars per lineal foot will be withheld from the unit prices of Items 15 and 16, stated in the Bid, for restoration and acceptance testing, in accordance with the Contract Documents. This amount shall not be considered part of retainage and shall not be released until restoration and testing has been satisfactorily completed, including but not limited to establishment of grass areas.

ITEM 31
EXISTING WATERMAIN STRUCTURE REMOVAL

31.01 DESCRIPTION

A. Under this Item, the Contractor shall remove concrete valve vault for connection of 30-inch watermain piping. Work shall include removal of the concrete structure, 30-inch valve, and existing piping as is necessary to install connection to the new work described in separate items. Work also includes restoration in the area of the structure removed as shown on the Drawings and specified.

31.02 WORK NOT INCLUDED

A. Any work detailed in other items.

31.03 DEFINITION OF ITEM

A. Item 31 - Includes existing watermain structure removal.

31.04 MEASUREMENT

A. The quantity to be paid under Item 31 shall be for each structure removed and restored including removal of the existing valve and suitable amount of 30-inch piping to facilitate installation of other items.

31.05 PAYMENT

A. The unit prices stated in the Bid for Item 31 shall be full compensation for each structure removed, so measured, as specified and required.

END OF SECTION

SECTION 01043

COORDINATION AND CONTROL OF THE WORK

PART 1 GENERAL

1.01 SCOPE

A. This section includes coordination and control of the work.

1.02 SUBMITTALS

A. Submittals shall be in accordance with all requirements of Section 01300 and shall include:

1. Information for the record:

a. Bypass Pumping plan and procedures.

b. Haul routes to and from project site.

c. Plan and procedures for any shut downs and bypass pumping.

d. Coordination drawings shall include, but not be limited to, all process piping including, but not limited to, bill of material, laying length, embedded conduit runs, and embedded plumbing lines.

1.03 LINES AND GRADES

A. All work under this Contract shall be built in accordance with the lines and grades shown on the Drawings or as altered or modified by authority of the Owner and Engineer.

1.04 EXISTING STRUCTURES SHOWN ON DRAWINGS

A. Where underground and surface structures are shown on the Drawings, the location, depth, and dimensions of such structures are believed to be reasonably correct but are not guaranteed.

B. Such structures are shown for the information of the Contractor, but information so given is not to be construed as a representation that such structures will in all cases be found or encountered just where shown, or that they represent all the structures which may be encountered.

1.05 COOPERATION OF CONTRACTOR

A. The Contractor shall conduct his operations so as to interfere as little as possible with those of the Owner, other contractors, utilities, or any public authority on or near the Work.

B. The Owner reserves the right to perform other work by contract or otherwise, and to permit other public bodies, public utility companies, and others to do work on or near the project during progress of the Work. If a conflict arises, the Owner will determine when and how the work shall proceed.

C. Claims for delay or inconvenience due to operations of such other parties on work specified, shown on the Drawings, as directed or which can be reasonably expected to be encountered by the nature and location of the Work will not be considered.

D. Operations entailing the use of construction equipment and lights outside the hours or 8:00 am and 5:00 pm or outside the hours allowed for construction by local ordinances or regulations.

E. Closing off clear access to any public alley, street, road, avenue or boulevard without the prior consent of municipal officials and the Engineer.

1.06 MAINTENANCE OF SANITARY SYSTEM DURING CONSTRUCTION

A. All construction which requires interruption of existing sanitary system flow shall be executed during periods designated by the Owner.

B. Bypassing of untreated sanitary wastewater to any stream or body of water is prohibited.

1.07 PERMANENT PAVEMENT AND FINAL RESTORATION

A. Permanent pavement and final restoration shall be completed prior to the close of the last paving season prior to the Contract's final completion.

1.07 PERMANENT PAVEMENT AND FINAL RESTORATION

A. When construction is being done between April 15 and November 1, the final pavement restoration work shall be complete by November 1.

B. Pavement restoration shall include, but not limited to, replacement of pavement, driveways, and sidewalks.

C. The fine grading, topsoil, and seeding operation shall be no further behind the pavement restoration than 150 lineal feet.

D. If at any time the pavement restoration and the fine grading, topsoil, and seeding operation does not meet the above conditions, no further mainline pipe laying will be permitted until the Contractor is in compliance.

E. In order to comply with the above conditions, the Contractor shall complete the pipeline and all appurtenances including, but not limited to, testing, in order to begin final pavement restoration and the fine grading, topsoil, and seeding operation.

1.08 RESERVED

1.09 TEMPORARY PARKING FACILITIES

A. Parking spaces for the Contractor's personnel shall be provided and maintained in usable condition by the Contractor at all times. Provisions shall be made so that sediment is not tracked onto paved roadways from the vehicles operated by the Contractor's personnel. The parking areas shall consist of temporary parking areas or new permanent parking areas shown on the Drawings. Temporary parking areas are to be located in the area designated by the Owner and Engineer. At the completion of the project, temporary parking areas shall be removed and the surface restored as specified, shown on the Drawings, as directed or to its original condition.

B. The Contractor's personnel shall not utilize existing permanent parking areas unless specifically noted otherwise on the Drawings.

1.10 TEMPORARY WATER, HEATING, LIGHTING, AND POWER

A. The Contractor shall provide all water, heat, lighting, and power required to construct and protect the work until Final Completion.

B. The source for temporary power shall be from the electric utility or portable power source.

C. The source for temporary water can be from the water utility if available. The Contractor shall furnish all backflow prevention devices, flow meter and appurtenances as may be required by the water utility. Should the water utility impose a charge for furnishing, to the

Contractor, the meter or appurtenances the Contractor shall pay all the fees. The Contractor shall pay all charges for the water metered.

1. If a water utility is not available, the Contractor shall be responsible for furnishing water and all cost associated including, but not limited to, procurement, hauling, pumping equipment, and appurtenances.

D. The Contractor shall pay for all significant amounts of electric power utilized by the Contractor in the construction of the facility. All electric power used for such significant uses as pumping groundwater and heating shall be separately metered and paid for by the Contractor.

E. The installation for electric power shall meet the requirements of federal, state, and local authorities and regulatory agencies.

1.11 DISPOSAL OF DEBRIS

A. All debris resulting from construction operations, i.e., packaging, waste materials, damaged equipment, etc., shall be trucked from the site by the Contractor and disposed of at spoil sites.

B. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely removed from public or private rights-of-way.

C. All debris shall be disposed of in accordance with federal, state, and local laws and regulations.

1.12 CONTROL OF NOISE

A. The Contractor shall eliminate noise to as great an extent as possible at all times. Air compressors shall be equipped with silencers and the exhaust of all gasoline motors and other power equipment shall be provided with mufflers. In the vicinity of hospitals, libraries, and schools, precautions shall be taken to avoid noise and other nuisance, and the Contractor shall require strict observances of all pertinent ordinances and regulations. Any blasting permitted in such locations shall be done with reduced charges.

1.13 SMOKE PREVENTION

A. Strict compliance with all ordinances regulating the production and emission of smoke will be required, and the Contractor shall accept full responsibility for all damage that may occur to property as a result of negligence in providing required control.

1.14 DEBRIS AND DUST CONTROL

A. The Contractor shall apply water, dust palliative, or both, for the alleviation or prevention of dust nuisance caused by his operations. Dust control operations shall be performed by the Contractor as site conditions dictate or as order by the Owner and Engineer.

B. The Contractor shall utilize mechanical equipment to remove all debris from all streets, drives and walks to the satisfaction of the Owner and Engineer. Cleaning shall be performed at a minimum of daily and as directed by the Owner and Engineer.

C. The cost of the all debris and dust control methods shall be the responsibility of the Contractor.

1.15 SANITARY REGULATIONS

A. The Contractor shall provide all necessary housing accommodations for the workers for changing clothes and for protection during inclement weather. Toilet accommodations shall also be maintained for the use of the employees on the Work. The accommodations

shall be in approved locations, properly screened from public observance and shall be maintained in a strictly sanitary manner. The Contractor shall obey and enforce all other sanitary regulations and orders; shall take precautions against infectious diseases and the spread of same; and shall maintain at all times satisfactory sanitary conditions around all shanties, tool and supply houses, and on all other parts of the Work.

1.16 USE OF EXPLOSIVES

A. When the use of explosives is authorized for the prosecution of the Work, the Contractor shall use the highest degree of care so as not to endanger life or property. The Contractor shall be responsible for any and all damage resulting from use of explosives.

B. The Contractor agrees and warrants that he will observe state laws and local ordinances and regulations relative to the use and storing of such explosives as may be kept on the job and all such storage places shall be marked clearly, "DANGER -- EXPLOSIVES".

1.17 EMERGENCY MAINTENANCE SUPERVISOR

A. The Contractor shall submit to the Engineer the names, addresses, and telephone numbers of two employees responsible for performing emergency maintenance and repairs when the Contractor is not working. These employees shall be designated in writing by the Contractor to act as his representative and shall have full authority to act on his behalf as specified in GC 6.2 of the General Conditions.

B. Contractor shall post at job site, in a conspicuous location, the emergency numbers for the project.

C. Contractor shall be responsible for contacting the local fire, police, and emergency response personnel and organizations in advance of the work. The Contractor shall be responsible for the coordination and compliance with emergency response plans, whether developed by the governing agency, laws, or the Contractor for the project.

D. At least one of the designated employees shall be available for a telephone call any time an emergency arises.

1.18 PUBLIC SERVICE STRUCTURES

A. Public service structures shall be understood to include all poles, tracks, pipes, wires, conduits, house-service connections, vaults, manholes, and other appurtenances, whether owned or controlled by the Owner or other public bodies or by privately-owned corporations, used to supply the public with transportation, heating, electric, telephone, gas, water, sewer, or other services.

B. At least a week in advance of breaking ground, the Contractor shall notify the registered underground protection service, all public bodies, and other owners of such facilities of the proposed location of his operations, advising them that their property may be affected and that such measures as they may deem necessary should be promptly taken to protect, adjust, remove, or build them.

C. In developed residential and commercial areas, the Contractor shall assume each building and dwelling has water and sewer services and that they shall be protected and repaired as needed as part of the pipeline installation. No additional payment will be made for work associated with supporting or repairs of such services.

D. Three conditions which may be encountered will be dealt with as follows:

1. Structures which are adjacent to but not included within the limits of an excavation required for performance of the Work shall be protected, supported, and maintained in service by the Contractor at his expense.

2. Structures within the limits of the Work which can be satisfactorily supported and maintained in service and which do not require removal and rebuilding in the judgment of the Engineer shall be thus supported by the Contractor at his expense, including cost of repair of damage incident to his operations.

   a. Supports for water and gas mains, sewers, conduits, and similar structures shall be constructed of timber or other acceptable materials; shall be supported from undisturbed foundations and shall be sufficiently substantial to ensure against settlement when pipe trenches or other excavations are backfilled. In all cases where permits or inspection fees are required by utilities in connection with changes to or temporary support of their conduits, the Contractor shall secure such permits and pay all permit and inspection fees.

   b. The Contractor shall assume full responsibility for maintaining all public service structures in service and shall support and protect or remove and rebuild them at his own expense. Such services shall not be interrupted without permission of the owner of the public service structure.

3. In case relocation of pipelines or other utility structures is required because of direct interference, as determined jointly by the Owner, Engineer, and Contractor, with the installation of the Work, the Contractor shall notify the Owners of the utility structure involved.

   a. The Contractor will not be reimbursed for the cost of the relocation if the interference is shown on the Drawings, described in the Specifications, apparent on visual inspection, or specifically included in the Work to be performed by the Contractor.

   b. The Contractor will not be paid for time lost because of such direct interference. Where it is the policy of any utility owner to perform such work with his own forces, the Contractor shall cooperate to the fullest extent with such utility owner.

1.19 UNAUTHORIZED WORK

A. Work done beyond the lines shown on the Drawings or ordered, work done without required inspection, except as herein provided, or any Extra Work done without authority will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so done may be ordered removed at the Contractor's expense. Work done without lines and grades being given shall be considered as unauthorized and subject to rejection.

1.20 DRAINING OF TANKS AND PIPELINES

A. Unless otherwise indicated, tanks, pipelines, and other similar structures that are to be removed from service, to complete the work will be initially drained by the Contractor.

B. Draining will be by gravity or by a permanently installed pump, if available.

C. After the tanks and pipelines have been drained to the lowest level possible with existing means for drainage, the Contractor shall remove and dispose of remaining liquid and accumulated solids, as required to complete the work.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

None.

PART 4 SPECIAL PROVISIONS

4.01 MAINTAINING FLOW IN EXISTING SEWERS

A. Flow in existing storm, sanitary and private sewers shall be maintained at all times during construction of this project. The Contractor shall furnish and install all necessary temporary facilities required to maintain the flow in existing sewers including bulkheads, plugs, stop planks, flumes, coffer dams, pumping equipment, valves, etc.

4.02 POTENTIALLY HAZARDOUS ENVIRONMENT

A. The environment in portions of the project site is rated as Class I Division 1 or 2 or some areas of the project site are designated as permitted Confined Spaces. As a minimum, whenever the Contractor is performing work in these areas, the Contractor shall provide Factory Mutual- and UL-approved continuous monitoring of the atmosphere for the presence of hydrogen sulfides, of low oxygen concentration, and of explosive gases (both lighter and heavier than air). The Contractor shall evacuate all personnel from the areas whenever the detection system registers hydrogen sulfide levels of greater than 20 ppm, oxygen levels less than 19.5% or combustible gas levels of greater than 10% of the LEL. In addition, whenever the Contractor is using tools producing open flames or sparks, such as cutting torches, saws, and grinders, the Contractor shall provide for the forced air exhaust ducted from the immediate area of the work.

4.03 REQUIRED SAFETY DOCUMENTATION TO BE SUBMITTED

A. On all projects that require the Contractor's or subcontractor's personnel to occupy permitted confined spaces and/or hazardous atmospheres on the project site, the Contractor shall submit to the Owner, a written proposed safety program. The safety program shall comply with all Federal, State, and local requirements. If the Owner has a safety plan that is more stringent than the Federal and State requirements, it will be made available to the Contractor for review. The submittal of the proposed safety program to the Owner shall be made well in advance of the start of construction at the project site. The submittal shall include a written Safety Management Plan including Confined Space Entry procedures. The Contractor shall be responsible to maintain documentation that anyone employed by the Contractor, subcontractors, or suppliers of any tier to the Contractor occupying such hazardous locations has received the appropriate confined space entry training and other applicable training. The Contractor is also responsible to maintain completed confined space entry permits.

4.04 MAINTAINING CRITICAL OPERATIONS

A. The Contractor shall closely coordinate any needed equipment shutdowns with the Owner. Except for the disinfection system which is addressed above, the Contractor shall not take out of service more than one piece of process equipment at a time.

4.05 SEQUENCE OF CONSTRUCTION

A. Contractor shall submit a detailed construction schedule outlining the progress of work and milestone dates for completion.

1. Yard piping work shall be completed per the documents prior to June 30, 2018.

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes reference standards.

1.02 DESIGNATION OF ASSOCIATIONS, INSTITUTIONS, SOCIETIES & STANDARDS

A. Whenever in these Specifications reference is made to Associations, Institutions, Societies, or Standards, they will be designated as follows:

AA	-	Aluminum Association
AAMA	-	Architectural Aluminum Manufacturers Association
AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ADAAG	-	Americans with Disabilities Act Accessibility Guidelines
AFBMA	-	Anti-Friction Bearing Manufacturers Association
AFI	-	Air Filter Institute
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
AIHA	-	American Industrial Hygiene Association
AISC	-	American Institute of Steel Construction
AISI	-	American Iron & Steel Institute
AITC	-	American Institute of Timber Construction
AMCA	-	Air Moving and Conditioning Association
ANSI	-	American National Standards Institute
API	-	American Petroleum Institute
ARI	-	Air Conditioning and Refrigeration Institute
ASA	-	American Standards Association
ASHRAE	-	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing Materials
AWS	-	American Welding Society
AWWA	-	American Water Works Association
BLS	-	Bureau of Labor Standards
CISPI	-	Cast Iron Soil Pipe Institute
FS	-	Federal Specifications
IBR	-	Institute of Boiler and Radiator Manufacturers
IEEE	-	Institute of Electrical and Electronic Engineers
ISA	-	Instrument Society of America
JIC	-	Joint Industrial Council
MDOT	-	Michigan Department of Transportation
NBS	-	National Bureau of Standards
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association

NFPA	-	National Fire Protection Association
NSF	-	National Sanitation Foundation
MIOSHA	-	Michigan Occupational Safety and Health Act
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association, Inc.
SSPC	-	Steel Structures Painting Council
MBC	-	Michigan Building Code
IBC	-	International Building Code
UBC	-	Uniform Building Code
UL	-	Underwriters Laboratories, Inc.
USBM	-	United States Bureau of Mines

B. Wherever specific standard numbers are indicated, i.e., ASTM C 150, it shall be understood to mean the latest revision thereof.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

None.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes requirements for submittals.

B. Contractor shall adhere to the submittal schedule as submitted under the provisions of the General Conditions. Contractor shall modify the schedule as required to allow sufficient time for submittal review based on current construction schedule.

C. Owner, Contractor and Engineer shall utilize the electronic project management system EPMS as specified in Section 01320 for the central repository of project related documents including but not limited to submittals, information for the record and O&M Manuals.

1.02 COORDINATION OF SUBMITTALS

A. The Contractor shall be responsible for the coordination of submittals and field verifications as required for the various parts of the work.

B. All submittals to the Engineer, unless otherwise specified, shall be made only by the Contractor. Direct submittals from subcontractors or suppliers will not be accepted.

C. All submittals shall reference the Specification item that it covers, the Contractor's name, the Contract title and location, and the date of submission. Submittal shall also indicate whether the information is for the Engineer's review and approval, for record purposes, or for the fulfillment of the operation and maintenance requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Two categories of information are normally required:

1. Shop Drawings for review.

2. Information for record.

a. Operation and Maintenance Manuals (O&M)

2.02 SHOP DRAWINGS FOR REVIEW

A. Shop Drawings:

1. The Contractor shall submit Shop Drawings in accordance with the General Conditions, as required by individual Sections, shown on the Drawings or as directed.

2. The Contractor shall indicate all variances from the requirements of the Contract Documents in accordance with the General Conditions.

3. The Contractor shall clearly indicate quantities and the exact intended use of the equipment or material contained in the submittal.

4. All Submittals shall be tailored to the project by high-lighting appropriate information and deleting or crossing out nonapplicable information or where

applicable the Contractor shall provide a data sheet with all necessary information to correctly identify the applicable Sections of the manuals for the actual material or equipment furnished. All options furnished shall be indicated.

5. Color charts or samples shall be included for all submittals where a color selection by the Owner is required. Original Color Charts (not Color Copies) and samples shall be delivered to the project site, Engineer's RPR or Owner as required. The Engineer shall be copied on the transmittal letter for record purposes.

B. Samples shall be provided as required in the individual Sections. Samples shall be of the precise material proposed to be furnished. The number of samples and sample size shall be the industry standard unless otherwise stated in the individual Sections.

2.03 INFORMATION FOR RECORD

A. Material certificates shall be submitted for materials as indicated in the individual Sections. The certificate shall state that the products have been sampled and tested in accordance with the proper industrial and governmental standards and meet the requirements of the Specifications. Certificates shall be signed by an authorized agent of the manufacturer.

B. Licenses and Permits - The Contractor shall submit copies of all licenses and permits required by Local, State, and Federal laws.

C. Installation and calibration certificates shall be submitted for equipment as indicated in the individual Sections. These certificates shall indicate manufacturer's satisfaction with the installation, the accuracy of calibration and alignment, and the operation of the equipment. Such certificates must be signed by an authorized agent of the manufacturer.

D. Progress Schedules shall be submitted in accordance with the General Conditions and Section 01310.

E. Schedule of Shop Drawings and Sample Submittals shall be submitted in accordance with the General Conditions.

F. Schedule of Values shall be submitted in accordance with the General Conditions.

G. Copy of programming for all PLC's, Drives, and computer controlled gear on the project.

2.04 OPERATION AND MAINTENANCE INFORMATION

A. Operation and Maintenance Manuals (a.k.a. O&M or Manuals) shall be submitted as information for the record.

B. O&M Manuals shall be submitted as electronic documents prior to the printing of the record copy.

1. Contractor shall provide one electronic copy of the manuals for preliminary review.

2. The final accepted manuals shall be provided as one electronic copy of the manual and one printed copy as specified below.

C. Electronic manuals shall be in Portable Document Format (PDF) as generated by Adobe Professional Version 7.0 or newer. The PDF file shall be fully indexed using the table of contents, searchable with thumbnails generated. PDF documents shall have bookmark created in the navigation frame for each major entry (Section, Chapter, Tab) in the table of contents. PDF images shall be at a readable resolution typically 300 dpi or higher. Optical Character Recognition (OCR) capture shall be performed on these images text can be searched, selected and copied from the PDF file.

1. The opening view of each PDF document shall be the bookmarks to the left and cover page or table of contents.

2. The PDF file name shall include the Name of Owner, Project title, Contract Number, and Specification Section. Commonly used abbreviations acceptable to the Owner may be used to minimize length of file name.

3. The Contractors Name shall be the electronic "Author" of the PDF document.

D. This information will be reviewed only if properly identified with Specification Section Numbers and only after revised, where necessary, to conform to the Engineer's notes on previous submittals that have been marked "Make Corrections Noted." Manuals shall be tailored to suit the specific equipment provided.

E. Submittals shall include but not limited to the following:

1. Descriptive literature, bulletins, or other data covering equipment or system.

2. Complete list of equipment and appurtenances included with system, complete with manufacturer serial number and model number.

3. Utility requirements.

4. General arrangement drawing.

5. Sectional assembly.

6. Dimension print.

7. Materials of construction.

8. Certified performance curve.

9. Parts list with assembly drawings.

10. Recommended spare parts list with part and catalog number.

11. Lubrication recommendations and instructions.

12. Schematic wiring diagrams.

13. Schematic piping diagrams.

14. Description of associated instrumentation.

15. Drive dimensions and data.

16. Operating instructions.

17. Maintenance instructions including trouble-shooting guidelines, lubrication, and preventive maintenance instructions with task schedule.

18. Special tools and equipment required for operation and maintenance.

19. Description of equipment controls.

20. Pump seal data.

21. Assembly, installation, alignment, adjustment, and checking instructions.

22. Confirmation of all corrections noted on Shop Drawings marked "Make Corrections Noted."

23. Manufacturer's name, address, and telephone number along with manufacturers job number and Purchase Order number.

24. Manufacturer's local sales representative, address, telephone number.

25. All installation instructions that were provided to Contractor for use to install equipment.

F. All manuals shall be tailored to the project by high-lighting appropriate information and deleting or crossing out nonapplicable information or the Contractor shall provide a data sheet with all necessary information to correctly identify the applicable Sections of the manuals for the actual equipment furnished. All options furnished shall be indicated.

G. Manuals shall be printed on 8-1/2 by 11-inch size with standard three-hole punching. Large manuals shall be submitted in three-ring binders. Small manuals shall be submitted in folders with metal fasteners. Index tabs shall be furnished for all manuals containing data for three or more items of equipment. All manuals shall have a title label on the cover stating the specification item number and item name. A table of contents shall be included in all manuals.

H. Drawings shall be reduced to 8-1/2 by 11 inch or 11 by 17 inch. Where reduction is not possible, larger drawings shall be folded separately and placed in envelopes which are bound into the manual.

I. Equipment installations shall not be considered substantially complete until all associated O&M submittals are accepted by the Engineer.

J. Field modifications to equipment during installation shall be included in the manual so that the manual reflects as-built conditions. Revisions to the manual may be submitted for incorporation into the manual where appropriate. However, the Engineer reserves the right to return all six manuals for revision to reflect as-built conditions.

PART 3 EXECUTION

3.01 IDENTIFICATION OF SUBMITTALS

A. All submittals shall have a Submittal Identification & Approval cover sheet attached. A sample of the submittal cover sheet is attached for reference. The form will be provided by Engineer and coordinated with Contractor.

B. All submittals shall be given a consecutive number when they are entered into the Electronic Project Management System (EPMS), See Section 01320.

C. Resubmittals shall be entered into EPMS as resubmittals.

D. Submittals to satisfy the Operation and Maintenance information requirements shall be entered into the EPMS as a submittal. The description shall have the prefix "OM".

3.02 PRINTING AND DISTRIBUTION

A. Contractor shall provide printed copies of approved submittals and deliver them to the Owner and Engineers RPR at the project site.

B. Contractor shall provide one printed copy of the approved O&M Manual and the electronic copy on portable electronic media device to the Owner.

C. Contractor shall provide printed copies of submittals, project information or documents required to satisfy the building permit and inspections as may be required by the governing agency.

1. The Engineer will provide the stamped/sealed Contract Drawings for the initial filing of the building permit applications.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

Submittal Identification & Approval

Date: **Spec Section**

Submittal No. **Drawing Sheet No.**

Description:

Manufacturer(s)

Contractor Comments/Deviations/Measu... ...s

Contractor

Contractor Nam...

☐	Approved
☐	Forwarded
☐	Checked

By: _____ Date: _____

Engineer

SHOP DRAWING REVIEW
SUBJECT TO CONTRACT REQUIREMENTS

Jones & Henry Engineers, Ltd.

☐	Approved
☐	Approved—Make Corrections Noted
☐	Amend & Resubmit
☐	Rejected—See Remarks
☐	Distribute for Information

REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. NO RESPONSIBILITY IS ASSUMED FOR CORRECTNESS OF DIMENSIONS OR DETAILS

Approval in no way relieves the Contractor of any responsibility for capacities, performance, functions, compliance with Federal, State, and Local Codes; accuracy of dimensions and details; or continuity and completeness of the Project nor does approval constitute or imply any increase in Contract Price.

By: _____

Review Comments

SECTION 01310

CONSTRUCTION SCHEDULES & DOCUMENTATION

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the requirements for construction schedules and construction sequences.

B. This Section includes the requirements for the tracking and documentation of the progress and activities driving the completion of the work as specified, shown on the Drawings and as directed.

1.02 SUBMITTALS

A. Submittals shall be in accordance with all the requirements of Section 01300 and shall include:

1. Information for the record:

a. Preliminary Construction Schedule.

b. Contractor's Construction Schedule and monthly updates.

c. Submittals Schedule.

B. Contractor shall submit three copies of the 24-inch by 36-inch construction schedule, unless approved otherwise by the Engineer.

1.03 QUALITY ASSURANCE

A. Scheduling conference shall be held prior to the commencement of the construction to discuss the following including, but not limited to:

1. Construction sequencing.

2. Contractor's coordination of subcontractors.

3. Coordination with the Owner's operations.

4. Coordination with other Contractor's or other work.

5. Project milestones.

6. Owner's partial utilization.

PART 2 PRODUCTS

2.01 PRELIMINARY CONSTRUCTION SCHEDULE

A. Preliminary construction schedule shall be completed in accordance with the General Conditions and prior to the scheduling conference.

B. The preliminary schedule shall outline the Contractor's sequencing of tasks, activities, milestones, and all critical path items within the contract time.

2.02 CONSTRUCTION SCHEDULE

A. The Contractor's submission of the construction schedule will not change the contract completion date, whether reviewed by the Owner and Engineer or not. The Contractor shall incorporate all approved change orders that have resulted in a contract time extension.

B. The Contractor shall require all subcontractors engaged in the work to submit to the Contractor construction schedules, as specified herein, for incorporation into the Contractor's construction schedule.

C. The construction schedule shall include, but not limited to, the following dates:

1. Notice to Proceed.
2. Substantial Completion and Final Completion.
3. Commencement of on-site operations.
4. Milestones as specified, shown on the Drawings, and as directed.
5. Ordering, submittals, fabrication, delivery, startup, and training time of major equipment items.
6. Submittal schedule per the General Conditions.

D. The Contractor shall incorporate into the construction schedule all constraints and work restrictions specified or otherwise required by the Contractor's operations, including, but not limited to, the following:

1. Construction sequencing.
2. Contractor's coordination of subcontractors.
3. Coordination with the Owner's operations.
4. Coordination with other Contractor's or other work.
5. Project milestones.
6. Owner's partial utilization.

2.03 UPDATING CONSTRUCTION SCHEDULE

A. The Contractor shall keep the construction schedule current to the progress of the work continually through closeout of the project. The construction schedule shall be submitted monthly for the Engineer's review.

2.04 WEEKLY CONSTRUCTION SCHEDULE

A. The Contractor shall submit a schedule of his work for each week. This schedule shall identify the foreman of each work crew and the location and type of work the crew will be doing each day. It shall be delivered no later than 4:00 p.m. of the next to last regular workday of the preceding week to the Resident Project Representative's office.

PART 3 EXECUTION

3.01 COORDINATION

A. All phases of the Work requiring interference with normal operations of the existing facilities shall be scheduled in accordance with agreements among the Contractor, Owner, and Engineer. The Contractor shall notify the Owner at least one week before such work is to begin.

PART 4 SPECIAL PROVISIONS

4.01 SCHEDULED NON-WORK DAYS

A. The Contractor shall restrict work to 6:30am to 4:30pm and consider the following list of holidays as mandatory non-work days, all of which shall be incorporated into the construction schedule:

1. New Year's Day
2. Martin Luther King Day
3. President's Day
4. Good Friday
5. Memorial Day
6. Fourth of July
7. Labor Day
8. Veteran's Day
9. Thanksgiving Day
10. Day after Thanksgiving Day
11. Christmas Eve Day
12. Christmas Day

END OF SECTION

SECTION 01320

ELECTRONIC PROJECT MANAGEMENT SYSTEM (EPMS)

PART 1 GENERAL

1.01 SCOPE

A. This section describes the requirements for the Electronic Project Management System (EPMS) which will be required on this project.

B. The Contractor shall be responsible for including the cost to the EPMS of $1,500.00. The Contractor shall be responsible for paying the cost as a onetime payment to Eastern Engineering within 30 days of the Notice to Proceed and will be considered part of the project mobilization on the schedule of values.

1. The EPMS shall be provided through eCommunication by Eastern Engineering, 866-884-4115; www.easternengineering.com .

C. Engineer will implement an internet/web site based Electronic Project Management System (EPMS) for the administration of the Contract on this project. Owner, Contractors and Engineer shall be responsible to interface with EPMS and collaborating via the EPMS on this project. The EPMS is intended to supplement the Contract Documents and the provisions of the Contract Documents shall not be superseded by the EPMS.

1. The EPMS is intended to provide a mode of communication which is electronic and to reduce the reliance upon printed documents. Printed documents transmitted will not be reviewed, and electronic documents emailed outside of the EPMS will not be reviewed. The Owner, Contractor and Engineer will collaborate on unique situations or circumstances in order to preserve the project electronic records.

D. The Owner, Contractor and Engineer shall be required to provide project related information/documents via EPMS. In general, the EPMS will receive information via uploaded documents as PDF documents, in their native format (when permitted or required), or other electronic formats designated or required for functionality. The EPMS shall be a central repository for information to all project team members. The EPMS will provide viewing, printing, up/down loading of various information/documents.

E. In general the following is a partial list of information/documents which shall be tracked through the EPMS:

1. Drawings, Specifications and Addendums (included revisions as necessary).

2. Insurance.

3. General Project Communication, Emails, Letters, Correspondence and Collaboration or any other document any participant wishes to make part of the project records.

4. Request for Information (RFI).

5. Submittals (Shop Drawings, O&M manuals, color selections etc.).

6. Work Change Directives, Change Request and Change Orders.

7. Schedule of Values, Pay Requests and Certified Payroll Reports.

8. Reports and Photos (daily, monthly, etc.).

9. Schedules (project, weekly and monthly).

10. Meeting Agendas and Minutes.

11. Permits and Special Inspections Reports.

12. Laboratory Services (testing and reporting).

13. Closeout procedures (deficiency list, warranty, substantial completion).

14. Record Drawings.

F. In an effort to protect proprietary information and prohibit unauthorized use or modifications, levels of access security will be assigned in order to provide safe and secure access to information with respects to involvement and responsibility on the project. The Owner, Contractor and Engineer shall establish these levels of access and rights which are appropriate for this project.

G. Owner, Contractor and Engineer shall utilize the mark-up tool integral within the EMPS or have a PDF review software that includes the ability to mark up and apply electronic stamps (such as Adobe Acrobat, or Bluebeam PDF Revu).

H. A high-speed internet connection is required.

I. The EPMS will provide notifications regarding new or updated documents through an existing Email account outside of the EPMS.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

3.01 CONTRACT REQUIREMENTS

A. All provisions of the Contract Documents are in full effect and enforcement. The submittal procedures specified in the Contract Documents are applicable with the understanding that they will be electronic documents and submitted via the EPMS.

3.02 PRINTING, REPRODUCTION AND DISTRIBUTION

A. The Engineer will not be responsible for printing reproduction or preparation of any hard copy documents, or the cost of doing so.

B. Contractor shall produce printed copies of all submittals as required in section 01300 and in the Contract Documents.

3.03 TRAINING

A. One training session by the Engineer and Eastern Engineering, Inc. will be provided to the team members at the beginning of the EPMS implementation. Training will be coordinated with the Preconstruction meeting and held at the same location. There are many tutorials, help features, and technical support options located on the Eastern Engineering web site.

B. Engineer will provide project related support as needed within their ability to provide it. Technical support will be available to all project team members from Eastern Engineering, Inc.

3.04 OPERATION

A. Contractor and all Subcontractors shall maintain a Windows-based computer system including high speed internet access and ability to create/mark-up documents using Adobe Acrobat (pdf) and to scan documents.

B. Engineer will facilitate the implementation and overall operation of the EPMS with Eastern Engineering. Eastern Engineering will provide and maintain the EPMS server and will back up the information.

3.05 ARCHIVE PROJECT CLOSE OUT

A. All files on the EPMS web site will be archived at the end of the project. These archives will be made available to the Owner, Contractors and Engineer for download over the internet, at the end of the warranty period.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 01350

COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes general requirements for all materials, equipment and systems furnished or installed under this project.

B. Additional specific requirements included under a particular Section shall take precedence.

C. This Section includes, but is not limited to, the following procedural and administrative requirements:

1. Product Delivery Storage and Handling.

2. Warranties.

3. Quality Assurance and Control.

1.02 SUBMITTALS

A. Submittals shall be in accordance with section 01300 and related specification sections.

B. The specification Sections and Drawings contain the specific submittal requirements.

1.03 QUALITY ASSURANCE

A. Where Contractor is required to provide design services or certification of the design, the specified product, equipment or system shall comply with the specified criteria.

1. Contractor shall submit a written request for clarification when specified criteria is incomplete or insufficient.

B. Manufacturer's name, make, model number and other designations provided in the contract documents are to establish the significant characteristics, including but not limited to, type, function, dimensions and physical properties, performance, and appearance for the purpose of evaluating comparable products. Contractor shall verify product, equipment or system proposed meets or exceeds the requirements as specified or shown on the Drawings.

1.04 PROJECT HANDLING

A. Schedule delivery to minimize the time goods are kept in storage.

B. Deliver goods to project site in manufacturer's original packaging.

C. Inspect the goods to determine if there is visible damage to the packaging.

1. The packaging shall be removed in a manner that will allow resealing for storage.

2. If packaging cannot be removed and reused, the goods shall be repackaged per the manufacturer's recommendations.

D. Goods that are susceptible to damage by the environmental or project conditions, including but not limited to, switchgear, motor control centers, panelboards, instrument control panels, fixtures shall be stored in a controlled environment per the manufacturer's recommendations. If no such area is available at the time such equipment is received, such space shall be provided by the Contractor at no expense to the Owner.

E. Where construction is in roads or streets, that portion of the right-of-way not required for public travel may be used for temporary storage purposes unless otherwise prohibited. Materials shall not be stored in areas where such storage creates a hazard. Any other additional space required for construction or storage of materials and equipment shall be obtained by the Contractor at his expense.

F. The Contractor shall confine his equipment, the storage of materials and equipment, and the operations of his workers to areas permitted by law, ordinances, permits, and the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

1.05 GUARANTEE

A. Manufacturer's warranty, extending beyond one-year after substantial completion for the specified product, equipment or system shall be provided to the Owner and endorsed by the manufacturer.

B. Requirements for warranties extending beyond one-year after substantial completion are described in individual Sections of these specifications.

C. Manufacturer's limitations and disclaimers shall not relieve the Contractor from warranty obligations under the Contract Documents.

PART 2 PRODUCTS

2.01 SHOP PAINTING

A. Non-galvanized ferrous surface shall be painted.

B. Shop painting of ferrous surfaces shall be as follows:

1. Surfaces shall be thoroughly cleaned of dirt, grease, oil, rust, scale, or other foreign substances. All metal surfaces shall, as a minimum, be abrasive blasted in accordance with SSPC-SP6, Commercial Blast Cleaning. More stringent surface preparation shall be provided where required by Section 09900.

2. Surfaces shall receive a shop coat of a primer compatible with the finish coating to be used by the Contractor and specified in Section 09900.

2.02 GALVANIZING

A. Where galvanized metal is indicated, unless otherwise specified, galvanizing shall conform to ASTM A-123 (Hot Dip Galvanized). Threaded parts and hardware shall be galvanized in conformance with ASTM A-153.

2.03 REGULATORY REQUIREMENTS

A. Materials, equipment, coatings, and chemicals in contact with potable water or water being treated for potable water use shall comply with the applicable NSF Standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Products shall be installed in accordance with the manufacturer's instructions and Contract Documents.

B. Required appurtenances including but not limited to, anchors, grout, and leveling shims, shall be provided.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 01410

LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall retain an independent laboratory.

B. Testing, inspection(s) and quality control are required to certify compliance with the Contract Documents.

1. The laboratory services do not relieve the Contractor from the responsibility of compliance with the Contract Documents

2. Any test required by the Owner shall not relieve the Contractor from the responsibility of compliance with the Contract Documents.

3. Any test required by the Owner shall not relieve the Contractor from the responsibility of supplying certificates from manufacturers or suppliers to demonstrate compliance with the Specifications.

C. Specific testing, inspection(s) and quality control requirements are specified in the individual Sections of the specifications.

D. Specific testing, inspection(s) and quality control requirements of any Federal, State or Local authorities are specified in the related sections of work.

E. Testing of materials or equipment for compliance with various national or technical society standards and ordinarily performed by manufacturers, and shop and field tests of equipment are not included under this Section but shall be performed by the Contractor or his supplier as specified elsewhere.

F. Contractor may conduct material or field test(s), inspection(s) and quality control as they deem necessary.

1. Should the Contractor, at any time, desire the Owner to consider the results of such testing, inspection(s), and quality control, such results shall be certified by an independent testing laboratory acceptable to the Owner. Any testing of this nature shall be conducted at the Contractor's expense.

1.02 SUBMITTALS

A. Submittals of all required field and laboratory test results shall be made by the independent laboratory as soon as they are available to the Owner and Engineer directly.

1. Statement of Compliance per 1.03.

1.03 QUALITY ASSURANCE

A. The laboratory shall be a recognized and independent commercial laboratory with experience in conducting the required tests.

B. Laboratory shall certify compliance with ASTM E 548, ASTM E 329, and ASTM C 1093 when masonry construction is part of the project scope. In lieu of ASTM certification, the laboratory may submit written documentation demonstrating experience and training relevant to the inspections to be performed. The documentation shall demonstrate

experience with projects of similar complexity and quantity of inspections as the project herein.

C. Testing, inspection(s) and quality control shall be certified by a professional engineer specialized in the related field and in the state where the project site is located.

PART 2 PRODUCTS

2.01 TESTS

A. Aggregates, Bedding Material, and Special Backfill - For each type of material, the laboratory shall perform an ASTM C-136 sieve and screen analysis to determine compliance with the contract documents.

1. Retests shall be performed until the Specifications are met.

2. Retest shall be performed each time the source of material is changed.

B. Selected Backfill - At the discretion of the Engineer, but in no case more than one test for each 1,000 cubic yards or portion thereof, the laboratory shall perform an ASTM C-136 sieve and screen analysis to determine whether the material is suitable for backfilling purposes.

C. Mix Designs:

1. For each type of controlled density fill, concrete, and asphalt, the laboratory shall review, perform test(s).

2. Review, perform test(s) and approve change in source of materials.

3. The asphalt design shall be made in accordance with ASTM D-1559, the Marshall Method of Mix Design and as specified.

4. Approved mix designs shall include sieve analyses and suppliers' certificates for materials incorporated in the mix.

D. Compaction Tests:

1. For each type of backfill material, the laboratory shall determine the moisture-density curve according to ASTM D-698.

2. Using ASTM D-2922 test methods, the laboratory shall determine the density of placed backfill.

3. Retests shall be performed if the compaction requirements stated in the individual Sections are not met.

4. The Engineer may at his discretion require the sand cone (ASTM D-1556) or the balloon (ASTM D-2167) tests for density and compaction to verify questionable results of the ASTM D-2922 tests.

E. The independent testing laboratory shall test and report the soil bearing capacity under all foundations and slabs on grade. The testing shall be conducted at regular intervals in all directions. The independent testing laboratory shall immediately notify both the Contractor and Engineer of any such test not meeting the presumed soil bearing capacity contained in the Structural Design Data on the Drawings.

F. Asphalt and Concrete Quality Control Testing - Perform tests as indicated in Sections 02600 and 03300.

G. Miscellaneous Tests - Perform all other tests requested in the individual Sections of the Specifications.

2.02 PLANT INSPECTIONS

A. Inspect and certify asphalt and concrete plants as indicated in Sections 02600 and 03300, respectively.

2.03 EQUIPMENT

A. Provide all necessary equipment to extract and store samples and perform the required tests.

PART 3 EXECUTION

3.01 COORDINATION

A. The Contractor shall provide the source of all materials requiring testing and shall arrange access for the independent laboratory to obtain representative samples and perform required tests at the material source. The information shall be supplied in advance to allow time for testing and reporting. Concrete information shall be supplied at least 45 days prior to the first concrete placement.

B. Contractor shall coordinate activities to accommodate the required quality assurance/control.

1. Contractor shall not compromise the requirement for quality assurance /control in order to maintain the schedule.

C. The laboratory shall conduct tests on materials and in locations as directed by the Resident Project Representative.

D. All tests shall be performed in accordance with the proper test methods mentioned above and in the individual Sections. Results shall be compared to the required values included in the individual Sections.

3.02 PREPARATION

A. Contractor shall prepare all work to be tested in accordance with the testing procedures as directed and required by independent laboratory, regulatory agency, or Owner and Owner's representative.

3.03 PROTECTION

A. Contractor shall at the completion of testing, repair damage to construction in accordance with these specifications.

B. Contractor shall be responsible for the protection regardless of the responsibility for quality assurance/control.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 01568

POLLUTION CONTROL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the requirements for pollution control.

PART 2 PRODUCTS

2.01 GENERAL

A. Dust palliatives shall conform to ODOT Item 616 or MDOT Item 922.08.

PART 3 EXECUTION

3.01 MICHIGAN GENERAL REQUIREMENTS

A. The Contractor is responsible to obtain and pay for NPDES Permit for storm water discharge.

B. The Contractor is responsible for following an erosion control plan in accordance with permits required under Act 451, Part 91, as amended (Soil Erosion and Sedimentation Control), Part 303 (Wetland Protection, formerly Act 203), Part 301 (Inland Lakes and Streams, formerly Act 346), Part 31, (Water Resources Protection, Floodplain Regulatory Authority, formerly Act 245 as amended by Act 167), and Part 31 (Water Resources Protection), National Pollutant Discharge Elimination System (NPDES). Secure Federal Section 404, Clean Water Act of 1972, permits, if required. Provide temporary and permanent erosion and sedimentation controls according to the permits.

C. It shall be the responsibility of the Contractor to prevent or limit pollution of air and water resulting from his operations.

D. The Contractor shall perform work required to prevent soil from eroding or otherwise entering onto all paved areas and into natural watercourses, ditches, and public sewer systems, and to prevent dust attributable to his operations from entering the atmosphere.

E. Water containing suspended material from any part of the Contractor's operations shall be clarified before discharging to drains or streams.

F. No fill, topsoil, or heavy equipment shall be stored within 200-feet of a stream bank or within the drip line of a treed area.

G. Excess soil that is stockpiled shall be removed or regraded within 15 days of the completion of construction.

3.02 STREETS, SIDEWALKS, AND DRIVEWAYS

A. Streets, haul roads, and detours and bypass roads shall be swept by automatic self-contained sweepers.

B. Excessive dirt on pavements shall be removed by means of hand shoveling or appropriate mechanical equipment and the area swept as directed above.

C. Sidewalks and driveways shall be cleaned by means of shovels and hand brooms or appropriate mechanical equipment.

D. Dust on unsurfaced streets or parking areas and any remaining dust on surfaced streets shall be controlled with calcium chloride dust palliative.

E. The Contractor shall comply with the above requirements on a daily basis. If the Contractor fails to perform the above work in a satisfactory manner, all work, except cleanup operations, shall be stopped until the Contractor has complied with the above requirement.

3.03 EROSION AND SEDIMENT CONTROL

A. The Contractor shall initiate appropriate vegetative practices on all disturbed areas to remain dormant (undisturbed) for more than 45 days within seven days.

1. Such practices may include: temporary seeding, permanent seeding, mulching, matting sod stabilization, vegetative buffer strips, phasing and protection of trees.

B. Permanent or temporary soil stabilization shall be applied to disturbed areas within seven (7) days after final grade is reached on any portion of the site.

C. When seasonal conditions prohibit the application of temporary or permanent seeding, non-vegetative soil stabilization practices, such as mulching and matting, shall be used.

D. A stabilization construction entrance shall be provided to reduce vehicle tracking of sediment. The paved street adjacent to the site entrance shall be swept a minimum of daily, or as needed, to remove any excess mud, dirt, or rock being tracked from the site.

1. Dust and sediment along any street due to construction on this site is to be swept a minimum of once at the end of the day or as necessary to prevent a build-up of dust and soil on the pavement surface.

E. Dump trucks hauling from the construction site shall be covered with a tarpaulin.

F. No more than 200-feet of trench shall be open at any given time. Trench opening, laying of pipe, and backfilling should occur so as to minimize the amount of disturbed area.

G. The Contractor shall minimize the width of his work area.

H. Existing trees, shrubs, and other ground cover vegetation shall be preserved where possible. Tree removal will be limited to that necessary for construction and will be limited further to the permanent easement wherever possible. No tree removal will be permitted outside the temporary easement.

I. Storm water runoff and natural stream flow shall be intercepted or diverted when originating upgrade away from the construction site so as to minimize the amount of flow over the construction site.

J. All dewatering flows are to be settled in siltation basins or directed through filters before discharge to stabilized sites, such as stream or storm sewers, and not onto exposed soils, stream banks, or any other sites where the flow could cause erosion.

K. When construction occurs near storm sewer inlets, erosion control measures such as inlet filters or hay bales shall be used to prevent silt from entering the storm sewers.

L. The clean-up and disposal of excess excavated material shall be done as soon as practical after laying of the pipe. However, clean-up work shall not fall behind the pipe laying more than 800-feet. Should the Contractor not keep his clean-up within the aforementioned distance, work shall stop until the clean-up work is accomplished.

3.04 MICHIGAN SEDIMENT CONTROL

A. Contractor shall control erosion and trap sediment from all sites remaining disturbed for more than 14 days. Such practices shall include among others, sediment traps, sediment basins, silt fences, and storm drain inlet protection. Silt Fence Fabric shall be in accordance with MDOT Item 910.04 Silt Fence Geotextile.

B. Timing - Sediment control structures shall be functional throughout earth-disturbing activity. Sediment ponds and perimeter sediment barriers shall be implemented as the first step of grading and within seven days from the start of grubbing. They shall continue to function until the upslope development area is restabilized.

C. Other erosion and sediment control practices shall prevent sediment-laden water from entering drain systems. Unless the storm drain system drains to a settling pond. These practices shall divert runoff from distributed areas and steep slopes where practicable and stabilize channels and outfalls from erosive flows.

3.05 RESERVED

3.06 RESERVED

3.07 PROHIBITED CONSTRUCTION ACTIVITIES

A. Disposing of excess or unsuitable excavated material in wetlands or floodplains, even with the permission of the property owner.

B. Locating stockpile storage areas in environmentally sensitive areas.

C. Indiscriminate, arbitrary, or capricious operation of equipment in any stream corridors, any wetlands, any surface waters, or outside the easement limits.

D. Pumping of sediment-laden water from trenches or other excavations directly into any surface waters, any stream corridors, any wetlands, or storm sewers; all such water will be properly filtered or settled to remove silt prior to release.

E. Discharging pollutants such as chemicals, fuels, lubricants, bituminous materials, raw sewage and other harmful waste into or alongside of rivers, streams, impoundments, or into natural or man-made channels leading thereto.

F. Permanent or unspecified alteration of the flow line of any stream.

G. Damaging vegetation outside of the construction area.

H. Disposal of trees, brush, and other debris in any stream corridors, any wetlands, any surface waters, or at unspecified locations.

I. Open burning of project debris without a permit.

J. Discharging injurious silica dust concentrations into the atmosphere resulting from breaking, cutting, chipping, drilling, buffing, grinding, polishing, shaping or surfacing closer than 200 feet to places of residences or places of human occupation.

K. Storing construction equipment and vehicles and/or stockpiling construction materials on property, public or private, not previously specified on the Drawings or not authorized by the Owner or Engineer for such purpose.

L. Running well point or pump discharge lines through private property or public property and rights-of-way without the written permission of the property owner and the consent of the Engineer.

PART 4 SPECIAL PROVISIONS

4.01 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. The Contractor shall be responsible for having a SWPPP prepared for the work. The SWPPP shall be prepared by an Engineer licensed in the state of Ohio.

B. The Contractor shall adhere to the SWPPP in accordance with MDEQ and Calhoun County Guidelines.

C. The SWPPP shall be updated and maintained throughout the work.

D. A copy of the SWPPP shall be available at the site's construction office.

4.02 SOIL EROSION AND SEDIMENTATION CONTROL PERMIT

A. Contractor shall be required to obtain a Soil Erosion and Sedimentation Control Permit from the Calhoun County Road Department prior to commencing any earth-disturbing work.

END OF SECTION

SECTION 01610

DISINFECTION OF POTABLE WATER STRUCTURES

PART 1 GENERAL

1.01 SCOPE

A. Under this Section, the Contractor shall furnish all materials, labor, equipment, and supervision necessary to clean and disinfect potable water structures. Disinfection shall comply with latest revision of ANSI/AWWA C652 Disinfection of Water-Storage Facilities and C653 Disinfection of Water Treatment Plants. The disinfection of the following structures shall conform to the requirements of this Section:

1. Clearwells.
2. Pump Suction Wells.
3. Water Filters.
4. Potable Water Storage Tanks.

B. All work performed under this Section shall comply and be in accordance with all approved trade practices and federal, state and local regulatory requirements.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

3.01 CLEANSING

A. Prior to disinfecting the structure(s), the Contractor shall remove all items not permanently part of the structure's interior and thoroughly clean and flush all interior surfaces with a high pressure stream of potable water. All debris and water from the flushing operation shall then be removed and disposed. Disposal shall meet federal, state, and local requirements.

3.02 DISINFECTION AND TESTING

A. After cleansing operations, the Contractor shall perform disinfection and bacteriological sampling and testing in accordance with ANSI/AWWA C652/C653.

B. When bacteriological tests performed after chlorination are not satisfactory, the Contractor shall reclean tank and repeat disinfection process.

C. When the disinfection operation is completed, potable chlorinated water furnished by Owner shall be used for initial filling. Water for initial disinfection shall be furnished by Owner. Water for subsequent tests or disinfections shall be furnished by the Contractor.

3.03 DECHLORINATION

A. The Contractor shall dechlorinate any chlorinated water used for cleansing or disinfection prior to its release to the environment or storm sewer by using a reducing agent per ANSI/AWWA C652/C653. The Contractor shall confirm no chlorine residual is present prior to disposal. Disposal shall meet federal, state, and local requirements.

3.04 COMPLIANCE WITH NPDES PERMITS

A. The Contractor shall ensure that any water used to meet these specifications is in full compliance with all applicable NPDES Permit requirements to a storm sewer or directly to the environment.

PART 4 SPECIAL PROVISIONS

4.01 DISINFECTION OF STRUCTURES SCHEDULE

A. The following structures shall be disinfected:

END OF SECTION

SECTION 01800

CONSTRUCTION SURVEY WORK

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing of all labor, materials, equipment, and services necessary for the completion of Construction Survey Work in accordance with the Contract Documents.

B. This Work consists of the layout of all lines and grades shown on the Drawings or as altered or modified by the Engineer, control survey and of miscellaneous survey work related to construction of the project.

1.02 PROJECTION

A. The Contractor shall protect and preserve the established reference points and monuments.

B. Whenever monuments are encountered in the line of work, whether shown on the Drawings or not, the Contractor shall notify the Engineer in writing at least 24 hours in advance of moving same, and under no circumstances is such a stone or other monument to be removed or disturbed by the Contractor or by any of his men without a written order of the Engineer and only when a registered surveyor representative of the Owner is present.

1.03 REPLACEMENT OF LOST SURVEY POINTS

A. Whenever a reference point or monument is lost or destroyed or requires relocation, the Contractor shall, at his own expense, accurately relocate and replace all such points so lost, destroyed, and moved.

1.04 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Information for the Record:

a. Layout Sheets including, but not limited to, Benchmarks both temporary and permanent and Pipeline layout staking.

b. Field Notes and survey log.

c. Profile over Proposed Tunneled, Jacked, or Bored Pipe.

d. Certified Survey of Tunneled, Jacked, or Bored Pipe.

B. Contractor shall provide the Engineer and Resident Project Representative, no later than five working days prior to installation, all Logs, reports, field notes, drawings and documentation as specified shown on the Drawings or directed

C. No pipeline or related work shall be considered for payment until all logs, reports field notes drawings and documentation as specified, shown on the Drawings or directed has been submitted to the Engineer or Engineers representative.

PART 2 PRODUCTS

2.01 CONSTRUCTION STAKING

A. All construction points shall be marked with a wooden hub and nail or a PK nails in concrete and asphalt pavements and walks.

B. All points located in areas of heavy underbrush, inaccessible or limited site distance shall be identified with a wood lath extending a minimum of 3 feet above the ground.

C. All points located in paved surfaces shall be clearly marked with paint. Contractor shall obtain written permission from owner to use paint for marking.

PART 3 EXECUTION

3.01 COORDINATION

A. The Contractor shall provide field forces necessary to lay out the location, alignment, elevation, and grade of the Work shown on the Drawings and in conformance with the control points and benchmarks shown on the Drawings.

B. The Contractor shall use competent personnel and suitable equipment for the layout of the work required. If the layout work involves more than a few simple distance and elevations from established reference points, the Contractor shall employ a Registered Surveyor to supervise the layout work.

C. Contractor shall furnish the necessary labor to assist the Engineer in checking the installation, if required.

3.02 EXISTING CONNECTION POINTS

A. The Contractor shall verify critical elevation points of the existing utilities prior to commencing installation of work. Critical points shall include all points where new work connects to existing utilities and existing utilities that could be conflicts with work. All data shall be provided to the Engineer before commencing work.

3.03 RESERVED

3.04 RESERVED

3.05 PIPE IN OPEN CUT

A. The Contractor shall utilize a laser beam for establishing line and grade when installing pipeline in open-cut construction. In order to maintain control during pipeline installation and to obtain the required field data for the record documents (G.C. 6.19) the Contractor shall establish construction and layout stakes. These stakes shall be based on the contract documents and the survey control data as provided by the Engineer.

B. The construction staking shall be placed along the pipeline route and at location of new valves, deflections both vertical and horizontal and as specified, shown on the Drawings or as directed. All construction layout stakes shall be offset at a minimum of 10-feet and at a right angle to the pipe line route. Layout shall be referenced to the downstream manhole or valve, in addition it may reference survey of baseline stationing.

C. Contractor shall provide to the Engineer, no later than five working days prior to the installation of the pipeline, all information of the completed construction layout staking. This information shall include but not be limited to stationing, elevations, control points, project coordinates, offset direction and distance for all deflections both horizontal and

vertical, manholes and all other points as specified, shown on the Drawings and directed by the Engineer.

D. The grade of pipe in open-cut, whether placed by laser beam or other approved methods, shall be checked using surveying equipment. The Contractor shall have a surveyor's level and level rod on the site at all times when pipeline and appurtenances are being installed. The level rod shall be equipped with an attached "shoe" extension on the bottom for placing on the pipe invert. The pipe invert elevation shall be checked at a maximum of 50-feet intervals or more often as directed by the Engineer. Checks will be performed by the Contractor and results, including but not limited to layout station shall be recorded in contractor's field log.

E. The Contractor shall furnish all equipment and labor and check his alignment from the offset stakes. Contractor shall record all information in the log.

F. Any inspection or checking of the Contractor's layout by the Engineer shall not relieve the Contractor of his responsibility to secure the proper dimensions, grades, and elevations of the work.

3.06 RESERVED

3.07 RESERVED

3.08 LOCATION OF STRUCTURES AND UNDERGROUND PIPING

A. The location of new structures and underground utilities shall be based on the dimensions, coordinates, and requirements shown on the Drawings or specified.

B. If it is stated on the Drawings or specified that the location and/or elevation of the new structure or underground piping shall depend on the location of existing underground or otherwise hidden facilities, those existing underground or hidden facilities shall be located by the Contractor prior to his determination of the location and/or elevation of the new facilities. This requirement shall override any other specific location dimensions or coordinates shown on the Drawings for that structure or piping.

C. If the location or elevation determined by the Contractor, in accordance with the above requirements, appears to cause conflicts with existing structures or utilities or appears to potentially cause functional issues with either the existing or new structures or utilities, the Contractor shall notify the Engineer immediately.

D. In no case shall coordinates or other location information be extracted or interpolated from the electronic CAD files that may be provided to the Contractor by the Owner or Engineer without the specific approval of the Engineer.

3.09 RESERVED

3.10 BENCHMARKS/VERTICAL CONTROL

A. Benchmarks have been set for survey and construction reference purposes.

B. The Contractor shall protect and transfer these benchmarks as needed to complete the work.

3.11 HORIZONTAL CONTROL

A. The layout provided is based upon physical control points found or established as part of the design.

B. The Contractor shall establish horizontal control as necessary.

PART 4 SPECIAL PROVISIONS

4.01 REGISTERED SURVEYOR

A. The Contractor shall employ the services of a registered surveyor for the initial layout and staking of the project. The Registered Surveyor shall be utilized at any time when reestablishing control points, elevations and on any redesign or extension of the work. All survey work shall be as specified, shown on the drawings or as directed.

END OF SECTION

SECTION 02110

REMOVAL OF STRUCTURES AND OBSTRUCTIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes demolition of existing structures and removal of pavement, piping, and equipment necessary to clear space for new construction and/or to rehabilitate existing construction.

1.02 SUBMITTALS

A. Submittals shall be in accordance with all requirements of Section 01300 and shall include:

1. Information for the record:

a. The Contractor shall submit, as specified, a copy of a signed permit from the owner of the property upon which the debris, removed under this Section, will be disposed.

b. Dust and noise control measures

c. Record documents, in accordance with the General Conditions, and photograph or video recording indicates the location of, but not limited to, the following existing, new, and abandoned:

1) Utilities,

2) Mechanical.

3) Electrical.

4) Structural.

5) Any embedded items.

d. Inventory and documentation list for removed and salvaged materials for the Owner.

1.03 QUALITY ASSURANCE

A. Contractor shall execute the work in compliance with all federal, state, and local codes. Any removal or demolition shall not leave the Owner in violation of any such regulations or codes unless approved by the Owner and Engineer.

1.04 PROTECTION

A. Structures shall be removed in such a manner as not to damage any portions of the existing structure which are to remain in place.

PART 2 PRODUCTS

2.01 FILL MATERIAL

A. Fill material shall be in accordance with Section 02200.

B. Temporary installations shall allow the plant to operate without impeding the operations of the plant and shall be approved by the Owner prior to use.

PART 3 EXECUTION

3.01 COORDINATION

A. Demolition work extending beyond the limits as specified, shown on the Drawings, or as required, will be considered unauthorized. The Contractor, at no additional cost to the Owner, shall repair said damage to a condition equal to or better than existed prior to commencement of the Work.

B. Existing structures and equipment which are damaged in appearance or function by performance of demolition work shall be replaced or repaired, at Owner's discretion and to an approved condition, by the Contractor at no increase in Contract Price.

3.02 PAVEMENTS, SIDEWALKS, CURBING, AND SIMILAR STRUCTURES

A. Removal of existing pavements, sidewalks, curbing, and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat, and free from chipped or damaged edges.

B. For removal of non-reinforced concrete, the minimum depth of saw cut shall be 3 inches.

C. For removal of reinforced concrete, the depth of saw cut shall be sufficient to cut the steel unless specified otherwise.

D. If the concrete is coated with a bituminous surface or other material, the depth shall be sufficient to cut into the concrete, not including the coating depth, as specified above.

3.03 MANHOLES, CATCH BASINS, INLETS, AND SIMILAR STRUCTURES

A. Existing manholes, catch basins, inlets, and similar structures designated to be removed shall be completely removed.

B. Manholes, catch basins, inlets, and similar structures designated to be abandoned shall be removed to an elevation of at least 3 feet below the finished subgrade or ground surface. The remaining void shall be filled with special backfill material compacted to 100 percent optimum density per ASTM D-698 or controlled density fill, CDF if permitted by the Engineer. All sewer openings in manholes located on sewer lines that are not to be filled, shall be plugged with 8 inch minimum thickness masonry plug.

C. All castings or hydrants salvaged from abandoned or removed structures shall remain the property of the Owner, if requested by the Owner, and shall be cleaned and transported by the Contractor to a site designated by the Owner or incorporated in the work where called for on the Drawings, scheduled, or so directed. If Owner decides salvaged materials are not wanted, the Contractor shall dispose of them at no additional cost to the Owner.

3.04 GROUT-FILLED ABANDONMENT OF PIPE, CONDUIT, AND SIMILAR STRUCTURES

A. Contractor shall determine and modify, as necessary, the mix of the flowable fill material to satisfactorily fill the entire abandoned sewers and structures. ACI 229R-99 Table 5.1 provides examples of acceptable mix designs.

B. Contractor may need to include fill holes and vent pipes to assure thorough filling. The locations of grout tubes, vents and inspection ports for grout filling pipes to be abandoned shown on the Drawing shall be considered the minimum number. The Contractor may choose to provide more grout tubes, vents, and inspection ports at no additional cost.

C. Quantities of flowable fill material used to fill the conduits shall be monitored continuously during the placement.

D. Bulkheads shall be installed as shown on plans and as needed by the Contractor's method to completely fill the abandoned sewers.

E. Sites disturbed by the grout-filled abandonment work shall be restored as part of this work.

3.05 GUARDRAIL AND FENCE

A. Where so required by the Drawings, existing guardrail and fence shall be carefully dismantled and stored for reuse or for salvage by the Owner.

B. Wood posts and other materials not considered salvageable by the Owner shall be disposed of by the Contractor.

3.06 RESERVED

3.07 EQUIPMENT REMOVAL

A. All equipment, valves, piping, fittings, and miscellaneous steel structures that are removed shall remain the property of the Owner and shall be stored at a site selected by the Owner. The Owner reserves the right to require the Contractor to dispose of certain unwanted portions of removed equipment and materials. The Owner shall have the right to reject any or all materials removed during construction, and the Contractor shall haul away and dispose of these materials in a suitable manner at no additional cost to the Owner.

B. The Contractor shall replace, at no cost to the Owner, equipment designated to be turned over to the Owner that is lost or damaged.

3.08 RESERVED

3.09 DISPOSAL OF DEBRIS

A. All debris resulting from demolition operations; i.e., broken concrete, masonry, pipe, miscellaneous metal, trees and brush, equipment, etc., shall be trucked from the work site by the Contractor and disposed of at spoil sites in a legal manner, in full compliance with applicable codes and ordinances.

B. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely cleaned up.

3.10 BACKFILLING

A. All trenches, holes, and pits resulting from the removal and abandonment of any structure or obstruction shall be backfilled and compacted in accordance with the requirements of Section 02200, Excavation and Backfill.

3.11 MAINTAINING OF PLANT OPERATIONS

A. Demolition shall be scheduled and performed in strict conformance with these Specifications and in a manner, which results in no interruption of treatment operations beyond that provided for and approved by the Owner and regulatory agencies. The date and time of commencing the separate items of demolition work shall be submitted to the Engineer for review, and no demolition work shall commence until the Engineer's approval of date and time is given.

B. All equipment, labor, and material costs which are made necessary by the requirements of the Sequence Plan, shall be borne by the Contractor.

3.12 USE OF EXPLOSIVES

A. The use of explosives for the work of removal of structures and obstructions is PROHIBITED.

3.13 PIPING REMOVAL

A. At the location where pipe removal stops, the remaining pipe end shall be capped. The cap must be pressure tight and restrained from movement due to pressures inside the pipe.

B. Piping removal includes, but not limited to, all hangers, stands, and anchoring devices.

3.14 RESERVED

PART 4 SPECIAL PROVISIONS

4.01 SCHEDULE OF REMOVALS

A. The following list of items once removed shall remain the property of the Owner and shall be delivered to the Owner-designated location.

1. Manhole Castings and Covers

4.02 BURIED SANITARY SEWER AND WATER MAIN REMOVAL

A. As shown on the Drawings, existing water main or sanitary sewer main piping, accessories, and appurtenances shall be removed within limits shown on the Drawings or as specified.

B. The removal shall include removal and disposal or aggregate backfill, pipe bedding and control density backfill.

C. Existing pipe removed shall become the property of the Contractor and shall be properly disposed of in accordance with the requirements of this Section.

D. At locations where the pipe removal is terminated, a water-tight sewer plug shall be placed in the end of the pipe to remain.

E. Manholes shall be removed to a minimum of 18-inches below grade.

4.03 VALVES, BOXES AND VALVE STRUCTURES ABANDONED

A. Manholes and valve box castings to be abandoned in place shall be removed to 18 inches below final grade and filled with low-strength mortar backfill in accordance to the bottom of the pavement typical section or to 12 inches below final grade in non-paved areas. The pavement section shall be removed and replace an additional 18 inches horizontally outside of the casting area. The void created by the removal of the casting, structure and valve box shall be backfilled to match the surrounding pavement section or as specified for non-pavement areas.

B. Valve boxes shown on the plans may also have existing manhole castings, frames, manhole structures around the existing valves. The abandonment of valves shall include the removal of all existing manhole casting, frame, and structure walls to be specified depths as associated with that particular valve.

C. Valve shall be abandoned in the off position when possible.

END OF SECTION

SECTION 02200

EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all excavations and related work for the construction of the designated structures, pipelines, and other incidental work.

B. Excavation includes the work of making all necessary excavations for the construction of all Contract Work; of furnishing, placing, and use of sheeting, shoring, and sheet piling necessary in excavating for and protecting the Work and workers; of doing all pumping and fluming necessary to keep the excavation free from water; of providing for uninterrupted flow of existing streams, treatment plant processes, drains and sewers; of damming and cofferdamming where necessary; of supporting and protecting existing structures, pipes, conduits, sewers, culverts of all types of materials of construction, of supporting and protecting railroad tracks, posts, poles, wires, fences, buildings, and other public and private property adjacent to the work; of removing and replacing existing sewers, culverts, pipelines, and bulkheads where necessary; of removing after completion of the work all sheeting and shoring not necessary to support the sides of excavations; of removing and disposing of all surplus excavated material or material under structures that does not meet the soil design bearing capacities; of doing all backfilling, of compacting backfill to limits specified or ordered by the Engineer; and restoring all property damaged as a result of the work involved in this Contract.

C. The Work includes obtaining and transporting suitable fill material from off-site when on-site material is not available.

D. The Work includes transporting surplus excavated material not needed for backfill at the location where the excavation is made, to other parts of the work where filling is required, or disposal of all surplus on other sites selected by the Owner.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Sieve Analysis (ASTM C-136) - One test for each material source.

b. Submit a moisture density curve (ASTM D-698) for each type of material used for backfill. Test shall be referenced to appropriate sieve analysis test. The maximum dry weight and optimum moisture content shall be indicated.

c. Controlled Density Fill Material - Design Mix and Certified Test Results.

d. Test results for conformance with specified "Compaction Requirements":

1) Retests shall be referenced to the corresponding failing test.

e. Stripped soil and topsoil test per .

2. Information for the Record:

a. When excess excavated material is disposed at locations off the project site, the Contractor shall obtain and submit written permission from the Owner of the property upon which the material is to be placed.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Soil stripped from the site shall consist of loose, friable, loamy topsoil without admixture of subsoil or refuse. It shall be reasonably free from peat, muck, roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks, litter, ground debris and wood products. The stockpiled soil shall be subject to the approval of the Engineer.

B. Topsoil provided shall be in accordance with MDOT 917 and be loose, friable, loamy soil without admixture of subsoil or refuse. In order for the topsoil to be considered loamy the fraction of topsoil, passing a No. 10 sieve, shall contain not more than 40 percent clay. Topsoil shall contain not less than 4 percent nor more than 20 percent organic matter as determined by loss on ignition of oven-dried samples to constant weight at 212 degrees F.

C. Excess material shall be removed from site, unless directed otherwise by Owner or Engineer.

2.02 SELECTED BACKFILL

A. Selected backfill shall be clean excavated soil. It shall be free of rock and foreign debris of any kind and shall be tested in accordance with ASTM C-136 sieve screen analysis and ASTM D-2487 soil classification. The material's use as selected backfill shall be approved by the Engineer.

B. Engineer may waive material testing of selected backfill. Such waiver shall apply only to the designated location and the source of the selected backfill. Such waiver shall not apply to excavated soil from locations not so designated.

2.03 SPECIAL BACKFILL MATERIAL

A. Special backfill material shall conform to MDOT 21AA.

2.04 AGGREGATE BEDDING MATERIAL

A. Aggregate bedding material shall be well-graded durable crushed gravel, crushed stone or meeting the graduation requirements of MDOT Table 902-1, Class 17A.

B. Aggregate bedding material shall be as follows:

1. For PVC, HDPE or plastic pipe diameters 10 inches and less, bedding material shall be No. 8 (nominal size 3/8-inch to sieve No. 8).

2. For PVC, HDPE or plastic pipe diameters over 10 inches, bedding material shall be No. 67 (nominal size 3/4-inch to sieve No. 4) or No. 8 (nominal size 3/8-inch to sieve No. 8).

3. All other aggregate bedding shall be No. 8, No. 67 or No. 57 stone. No. 57 (nominal size 1-inch to sieve No. 4) shall not be used for bedding PVC, HDPE or plastic pipes.

C. Fine aggregate bedding material shall be natural sand or manufactured sand bedding material meeting the requirements of MDOT Table 902.08 and MDOT Table 902-8.

2.05 CONTROLLED DENSITY FILL (CDF) MATERIAL

A. Controlled density fill material shall be a cement base fill material that can be deposited in a fluid state. It shall be composed of portland cement and approved filler material, sand and water. The mixture and shall have a compressive strength of 100 psi minimum and 500 psi maximum:

B. Filler material shall consist of mineral aggregates, slag, or fly ash. Metals, soil, or organic material will not be permitted.

2.06 RESERVED

PART 3 EXECUTION

3.01 COORDINATION

A. Construction:

1. Permits - Contractor shall be responsible for compliance with and furnishing any item required by permit such as Soil Erosion and Sedimentation Control.

3.02 REMOVING AND REPLACING TOPSOIL

A. Removal

1. Excavation for trenches in which pipelines, sewers, conduits and other utilities are to be installed: The Contractor may elect to strip soil and stockpile unless the Contract Documents direct stripping and stockpiling prior to excavation.

2. General excavation, other than trench excavation: The Contractor shall remove, and stockpile the top 12 inches of the existing soils from all areas of construction including, but not limited to, excavation and embankment areas, stockpile sites, construction yard, storage areas, etc.

B. Replacing stockpiled soil and topsoil

1. Trench excavation areas disturbed as a result of trenching operations and which are to be restored with grass or other plantings shall be free of peat, muck, roots, hard clay, coarse gravel, stones, weeks, tall grass, brush, sticks, litter, ground debris and wood products. The surface shall be mechanically conditioned after removal of debris. After surface is prepared, it shall be covered with topsoil or stockpiled soil material to a minimum depth of 4 inches. Topsoils and stockpiled soil material shall meet the requirements specified herein and be tested.

2. General excavation areas which are to be restored with grass or other plantings shall be free of peak, muck, roots, hard clay, coarse gravel, stones, weeks, tall grass, brush, sticks, litter, ground debris, wood products and construction debris including loose stone. The surface shall be mechanically conditioned after removal of debris. After surface is prepared it shall be covered with stockpiled soil and then have a minimum of 4 inches of topsoil placed.

3.03 GENERAL EXCAVATION

A. All necessary excavation shall be performed to accommodate the completion of all Contract Work.

B. The Drawings show the horizontal and the lower limits of structures, pipelines, sewers and other utilities. The methods and equipment used by the Contractor when approaching the bottom limits of excavation and when trimming the bottom of the excavation to a smooth

surface shall be selected to prevent disturbing the soil below the bottom limits of excavation.

C. Excavation which is carried below the bottom limits shall be classified as Unauthorized Excavation, unless said excavation has been authorized by the Engineer prior to each occurrence.

D. Unauthorized Excavation shall be filled with CDF material to the bottom limits. Under circumstances where structural integrity is not a factor, the Engineer may allow the filling of Unauthorized Excavation with pipe bedding material or special backfill material compacted to 100 percent density, as specified under compaction requirements.

E. Removal of Water:

1. The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the work and shall keep said excavations dry until the structures to be built or pipelines to be placed therein are completed. No water shall be allowed to rise over or come in contact with concrete or masonry until the concrete and mortar has attained a satisfactory set, except in cases where the concrete has been tremied into place with the approval of the Engineer. Water shall not be allowed to rise above the bottom of the bedding stone prior to placing pipe. In waterbearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation free of water and in compliance with government regulations.

2. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property or structures and in compliance with all regulations.

3.04 TRENCH EXCAVATION

A. Excavation for trenches in which pipelines, sewers, conduits and other utilities are to be installed shall provide adequate space for workers to place and joint the pipe properly. The trench shall be kept to a minimum width. The width of trench at the top of the pipe shall comply with the limits specified or shown on the Drawings.

B. Excavation shall be to the depth necessary for placing aggregate bedding material under the pipeline, sewer, conduits and other utilities as shown on the Drawings. If over excavation occurs, the trench bottom shall be filled to grade with compacted aggregate bedding material.

C. The amount of trench open at any one time in advance of completed work shall be limited to the minimum necessary for conducting laying operations.

D. In general, backfilling shall begin as soon as the pipeline, sewer, conduits and other utilities are in a condition to receive it and shall be carried to completion as rapidly as possible. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe condition.

3.05 EXCAVATION OF UNSUITABLE MATERIAL

A. Unsuitable materials existing below the Contract bottom limits for excavation shall be removed as required by the Engineer. The Engineer may rely upon the independent laboratory retained on this Project when determining unsuitable soil conditions, removal and backfill. Such excavation shall be conducted at a time when the Engineer and independent laboratory are present and shall not exceed the vertical and lateral limits prescribed by both.

B. The voids left by removal of unsuitable material shall be filled with special backfill, pipe bedding material, or CDF material as listed in Part 4 or as prescribed by the independent laboratory and as approved and ordered by the Engineer. Special backfill or pipe bedding shall be installed as described in this Section and in general shall be compacted to 100 percent density as specified under compaction requirements.

3.06 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

A. All excavated materials which are unsuitable for use in backfilling trenches or around structures, and materials excavated that are in excess of that required for backfilling and for constructing fills and embankments as shown on the Drawings, shall be disposed of by the Contractor at his expense and at sites provided by him as may be required, except that the Owner reserves the right to require the Contractor to deposit such surplus at locations designated by the Owner within a five-mile radius of the Work.

B. No surplus excavated material of any class shall be deposited in any stream or watercourse or be dumped on public property without the consent of the Owner. All spoil areas shall be left smooth, level, with drainage to a water course and proper erosion and runoff control shall be used.

3.07 BACKFILL AND COMPACTION

A. Pipe and Conduit Bedding - Unless otherwise directed, pipe, conduits and other utilities shall be installed in specified aggregate bedding material as shown on the Drawings and as specified.

B. Backfilling Under Existing Pipeline, Sewer, Conduits and Other Utilities - Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with aggregate bedding material tamped in place in 6-inch layers to the required density. The aggregate bedding shall extend outward from the spring line of the conduit a distance of 2-feet on all sides and thence downward at its natural slope.

C. Backfilling with Selected Backfill - Unless otherwise specified or directed, material excavated in connection with the work may be used for backfilling and other filling purposes, if it meets all requirements given elsewhere in this specification for selected backfill. No material shall be used for backfilling that contains stones, rock, or pieces of masonry greater than 12 inches, frozen earth, debris, earth with an exceptionally high void content, organic material, or marl. No large pieces of rock or masonry shall be deposited closer than 24 inches from the completed outside surface of any structure or pipe.

D. Backfill Immediately - All trenches and excavations shall be backfilled immediately after completion of construction therein, unless otherwise directed by the Engineer. Under no circumstances shall water be permitted to rise in unbackfilled excavation during construction or after pipe has been placed.

E. Backfilling around and over structures, pipelines, conduits and other utilities comprising the work shall be carefully done by hand and tamped with suitable tools of approved weight when within 2 feet of structures, pipeline, conduit and other utilities. Selected backfill or, where specified, shown on Drawings, or ordered by the Engineer, special backfill material shall be used in this area. The material shall be placed in uniform layers not exceeding 6 inches in depth up each side. Each layer shall be placed, then carefully and uniformly tamped to the specified density so as to eliminate the possibility of lateral displacement of pipe or structure.

F. Backfilling may be done by machinery after the backfill has been placed and compacted beyond 2 feet horizontally of structures, pipelines, conduits and other utilities and to a minimum depth of 1 foot above the tops of any buried structures, pipelines, conduits, and other utilities. The backfill material shall be deposited in horizontal layers, not thicker than one foot, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfill material from a bucket be allowed to fall directly on a structure or pipe and in all cases the bucket must be lowered so that the shock of the falling material will not cause damage.

G. Backfilling Under Pavement and Walks - Where existing or new pavement, driveway, parking lot, curb and gutter, or walk is over an excavation, special backfill material shall be used to backfill the entire excavation from the bedding to surface. The material shall be placed and compacted to the required density in accordance with one of the following methods:

1. The backfill material shall be deposited in 6-inch horizontal layers and each layer shall be thoroughly compacted to the proper density by approved compaction method before a succeeding layer is placed.

2. No method of compaction which alters the gradation of the special backfill material or prevents compaction testing by standard testing methods shall be used.

H. Backfilling with Controlled Density Fill Material (CDF) - Where called for on the Drawings, specified, or ordered, CDF material shall be used in lieu of special backfill or bedding material specified herein. Before placing CDF material, the Contractor shall take required measures to protect the work against flotation.

3.08 COMPACTION REQUIREMENTS

A. In areas to be filled, after the top 12-inches of soil is stripped, then the undisturbed subgrade shall be compacted to not less than 100 percent of maximum dry density per ASTM D-698 (Standard Proctor) prior to placing of fill.

B. Backfill placed around structures where other structures, pipelines, or slabs are to be constructed shall be compacted to not less than 100 percent of maximum dry density per ASTM D-698.

C. The material used to construct embankments and fills in locations other than under pavements, walks, structures, or slabs and around and over pipelines, shall be compacted to not less than 95 percent of maximum dry density per ASTM D-698.

D. All other backfill, including backfill around and over pipelines, and backfill around structures not covered in Paragraphs B. and C. above, shall be compacted to not less than 95 percent of maximum dry density per ASTM D-698.

E. The bottom of excavations upon which concrete slabs or structures are to be placed shall be compacted to obtain 100 percent maximum dry density per ASTM D-698 in the top 12 inches.

F. Subgrade under structures shall be compacted to a depth of 12 inches below bottom of excavation surface to a density of not less than 100 percent of the maximum dry density determined by ASTM D-698.

3.09 COMPACTION TESTS

A. Trenches and excavation around structures shall be backfilled and consolidated in layers, as specified, to the existing ground surface. Initial test series for each type of backfill material shall be continued until the method of consolidation employed has proven to attain

the required compaction. Any change in the proven method of consolidations will require additional testing and field verification of compaction.

B. Subsequent tests or series of tests shall be in locations and at depths ordered by the Engineer.

3.10 RESERVED

3.11 RESERVED

3.12 RESERVED

PART 4 SPECIAL PROVISIONS

4.01 FIELD TESTING (MINIMUM REQUIREMENTS)

A. The laboratory shall perform the following field tests:

1. Trench Backfill - One test for every 200 cubic yards of backfill material.
2. Subgrade Compaction - One test for every 300 square yards of subgrade.
3. If directed by the Engineer, additional tests shall be performed for any of the above.

4.02 PERMITS

A. Calhoun County - Soil Erosion and Sedimentation Control Permit.

END OF SECTION

SECTION 02555

PRESSURE PIPE

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing pressure pipe of the materials, class, size, and length as shown on the Drawings, specified, or directed.

B. Pressure pipelines constructed under this Section shall include but not be limited to water mains and sewer force mains.

C. This Section shall include furnishing and installing all required pipe, fittings, specials, adaptors, blind flanges, reducing flanges, closure pieces, tees, bends, joint restraints, granular pipe bedding material, Class B concrete used for encasement or bedding, removing and relaying existing pressure pipe as required, providing temporary services and temporary blocking or harnessing, making connections to new and existing pressure pipe, installing temporary bulkheads and plugs, testing pipe, cleaning and sterilizing water mains, and other work incidental to the pressure pipe installation, unless specifically included under other Items.

1.02 SUBMITTALS

A. Submittals shall be in accordance with all requirements of Section 01300 and shall include:

1. Shop Drawings for review:

a. Manufacturer's Shop Drawing indicating physical dimensions, joint details, fittings, and special details for each size, type, and class of pipe furnished for the project. Shop Drawings shall also note salient features of a specific pipe, i.e., concrete strength and reinforcing details.

b. Samples, if requested by the Engineer.

2. Information for the record:

a. Manufacturer's certification indicating that the pipe and joints meet Specifications for each production run for each size, type, and class of pipe furnished. The Engineer may request test results to verify certification.

1.03 PRODUCT HANDLING

A. Care shall be taken in handling and transporting to avoid damaging pipes and their coatings. Loading and unloading shall be accomplished with the pipe under control at all times and under no circumstances shall the pipe be dropped. Pipe shall be securely wedged and restrained during transportation and supported on blocks when stored in the shop or field.

PART 2 PRODUCTS

2.01 PRESSURE PIPE SPECIFICATIONS

A. Ductile Iron Pressure Pipe:

1. Ductile Iron Pressure Pipe (DIP) shall conform to ANSI A-21.51 or AWWA C-151 and shall be pressure class 350 psi for sizes 12-inch and below, and pressure class 300 psi for larger sizes unless otherwise specified herein. Pipe shall be Clow

Water System – Tyton Joint Pipe or equal. Mechanical joint fittings shall be ductile iron and conform to ANSI A-21.10 or AWWA C110 and ANSI A-21.53 or AWWA c-153. Flanged fittings shall be ductile iron and conform to ANSI A-21.15 or AWWA C115. All fittings shall have a pressure rating of 250 psi for all pipe sizes unless otherwise specified. Ductile iron pipe buried underground, unless otherwise specified or shown, shall have rubber gasket (slip-on) type joints in straight runs and mechanical joints with retainer glands each way from bends as shown on the Drawings. The gasket shall be a single molded rubber ring fitted into a specially shaped recess in the bell forming a pressure tight seal. The spigot end of each pipe shall be marked to indicate when the pipe is "home." Fittings shall have mechanical joints with retainer glands unless otherwise specified or shown. Retainer glands shall be ductile iron. The restraining mechanism shall impart multiple wedging action against the pipe. Restraining devices shall be of heat treated ductile iron. Twist-off nuts shall be used to ensure proper actuation of the restraining device. The mechanical joint retainer gland shall be Ebaa Iron, Inc., Series 1100 Megalug, or equal.

2.02 PRESSURE PIPE JOINTS

A. Ductile Iron Pipe:

1. Pipe buried underground, unless otherwise specified, shall be jointed with rubber gasket (push-on) type joints and shall meet the requirements of AWWA C-111 for push-on joints. The gasket shall be a single molded rubber ring fitted into a specially shaped recess in the bell forming a pressure tight seal. The spigot end of each pipe shall be marked to indicate when the pipe is "home." Fittings shall have mechanical joints with retainer glands unless otherwise specified or shown. Retainer glands shall be ductile iron. The restraining mechanism shall impart multiple wedging actions against the pipe. Restraining devices shall be of heat treated ductile iron. Twist-off nuts shall be used to ensure proper actuation of the restraining device. The mechanical joint retainer gland shall be Ebaa Iron, Inc., Series 1100 Megalug, or equal.

2. Mechanical joints, wherever specified or shown, shall conform to ANSI A-21.11 (AWWA C-111), except as specified herein.

3. Mechanical couplings, if required or permitted, shall be Dresser Style 38, or equal.

4. Restrained joints, wherever shown or required, shall be mechanical joint with retainer glands, U.S. Pipe TR Flex Joint System, U.S. Pipe Field LOK Gasket System, or equal.

5. Flange adapters for plain end pipe (not fittings), where specified, shown on Drawings, or approved by Engineer shall be a restrained flange adapter. The restraining mechanism shall be multiple gripping wedges set against the pipe wall. Twist off nuts shall be used to ensure proper actuation of the restraining device. The restrained flange adapter shall be Series 2100 Megaflange by Ebaa Iron, Inc., or equal.

2.03 ACCESSORIES

A. Nuts and bolts for buried pipe shall be as follows:

1. Nuts and bolts used on buried pressure pipe and fittings in contact with earth shall be Cor-Blue coated low alloy steel and have a minimum yield strength of 45,000 psi complying with ANSI A21.11 and AWWA C-111.

2.04 COATINGS AND LININGS OF PRESSURE PIPE

A. Ductile Iron Pipe:

1. Interior Linings / Cement Lining - Unless otherwise specified, pipe interiors shall be covered with a standard thickness cement lining meeting ANSI A-21.4 and AWWA C-104. A seal coat of petroleum asphaltic material shall be applied in conformance with the above Specifications. Pipe used for compressed air shall not receive a concrete lining.

2. Exterior Coating:

a. All cast pipe buried underground shall be coated on the outside with a standard petroleum asphaltic coating, 1 mil thick, meeting AWWA C-110, unless otherwise specified. The finished coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe. The coating materials, after drying 48 hours, shall impart no objectionable color, odor, or taste to water standing in contact with the coating for a minimum of 48 hours.

b. Where approved, the petroleum asphaltic material specified for interior lining may be used for exterior coating of pipe buried underground.

2.05 RESERVED

2.06 SOURCES QUALITY CONTROL

A. Pipe Manufacturer's Certification:

1. The pipe manufacturer's certificate shall state that the materials have been sampled and tested in accordance with the provision for and meet the requirements of the designated specification and shall be signed by an authorized agent of the seller or the manufacturer.

2. A test results report shall accompany the manufacturer's certificate, if requested by the Engineer. The report shall compare test results to Specification requirements. Test specimens shall be selected in conformance with the designated specification for each production run of each size, type, and class of pipe furnished and further, that in case tests are unsatisfactory, additional tests shall be made to the maximum number in the referenced ASTM Specification.

PART 3 EXECUTION

3.01 COORDINATION

A. Construction in Highway Properties

1. Construction in highway properties shall conform to the requirements of Section 02200.

3.02 PREPARATION OF TRENCH

A. Trench excavation shall conform to requirements of Section 02200.

B. Unless otherwise specified or called for on the Drawings, the width of trench at the top of pipe 24 inches in diameter or less shall not exceed the outside diameter of the pipe or encasement, plus 9 inches on each side of the pipe measured to the face of the trench or to the back of the sheeting when used. For pipe having a diameter greater than 24 inches, the

width of trenches at the top of the pipe shall not exceed the outside diameter of the pipe or encasement, plus 15 inches on each side of the pipe measured as specified above.

C. Unless otherwise directed or called for on the Drawings, all sewer trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.

3.03 PIPE INSTALLATION

A. All pipe fittings and specials shall be laid in accordance with the manufacturer's instructions, with AWWA C-600, and as supplemented herein.

B. Precautions shall be taken during construction to protect the pipe interiors, fittings, and valves against contamination. Pipe interiors shall be thoroughly cleaned of dirt and foreign matter before laying, by brushing, swabbing or other method approved by the Engineer, and means shall be provided to prevent entry of dirt during the progress of installation. Groundwater shall be kept out of the pipe at all times.

C. Bedding and Backfilling:

1. Bedding and backfilling shall be in conformance with Section 02200.

2. At joints enough depth and width shall be provided to permit working entirely around the pipe as needed to make the joints in the proper manner.

D. Handling and Cutting:

1. Suitable tools and appliances for cutting, handling, and laying of the pipes and special castings shall be used and care shall be taken to prevent damage to pipe coatings.

2. Where new or existing pipe requires cutting in the field it shall be done in a manner to leave a smooth end at right angles to the pipe centerline. The finished cut must be approved by the Engineer.

E. Pipe Laying:

1. Pipe and appurtenances shall be installed true to line, grade, and location; with joints centered, spigots home; pipe properly supported and restrained against movement; and all valve stems plumb.

2. All elbows, tees, plugs, etc., shall be properly anchored, blocked, or otherwise restrained to prevent movement of the pipe in the joints due to internal or external pressure.

3. The open ends of all pipes and special castings shall be plugged or otherwise closed with a watertight plug to the approval of the Engineer before leaving the work for the night, and at other times of interruption of the work. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.

F. Pipe Jointing:

1. Gaskets - Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge

supplied by the pipe manufacturer. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced. The pipe is then forced "home" firmly and fully. In its final position, the joint between the pipes shall not be deflected more than 1/2 inch at any point.

G. Anchoring Pipe:

1. Disjointing hydrostatic pressure at bends, plugs, tees, and wyes shall be counteracted by thrust blocks, restrained joints, or reinforced concrete anchorage as directed on the Drawings or specified.

2. Approved joint restraints shall be installed in locations shown or scheduled on the Drawings.

3.04 RESERVED

3.05 FIELD INSPECTION

A. All pipe sections, specials, and jointing materials shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered installed shall be removed and replaced with a sound one in a manner satisfactory to the Engineer at the Contractor's expense.

B. Defective material shall be marked with lumber crayon and removed from the job site before the end of the following day.

3.06 PRESSURE AND LEAKAGE TESTS

A. The Contractor shall furnish the pump, pipe connections, taps, gauges, auxiliary water container, bulkheads, plugs, and other necessary equipment and make pressure and leakage tests of all lines unless otherwise directed by the Engineer.

B. Tests shall be conducted on all pipelines or valved sections thereof as directed by the Engineer. Testing of pipelines laid in embankments or bedded in concrete shall be done prior to backfilling or placing concrete cover unless otherwise permitted by the Engineer. Tests on lines anchored or blocked by concrete shall not be conducted until the concrete has taken permanent set. A maximum of 1,000 feet of pipe may be included in a test section. All valves shall be tested for leakage.

C. The line or section thereof to be tested shall be filled slowly with water to expel all air. Hydrostatic pressure shall be applied by pumping water from an auxiliary supply. The test pressure shall be maintained two hours minimum and additional time as required for thorough inspection to find any leaks or defects in the force main and appurtenances. The test pressure shall be 150 pounds per square-inch or 50 percent above the normal operating pressure, whichever is greater. Should the pipe section fail to pass the tests, the Contractor shall find and correct failures and repeat the tests until satisfactory results are obtained.

D. The maximum allowable pressure variation shall be +/- 5psig.

E. Leakage tests shall be made simultaneously with or following completion of pressure tests of all lines or valved sections thereof. Leakage is defined as the quantity of water added to the pipe under test to maintain the required test pressure for a specified time.

F. Leakage is defined as the volume of water that must be supplied into the newly laid pipeline to maintain pressure within ± 5 psi of the test pressure after it is filled and purged of air. Measure the volume of water using a calibrated container or meter.

G. No pipeline installation will be accepted if the leakage is greater than that calculated as such:

$$L = \frac{S * D\sqrt{P}}{148{,}000}$$

Where:
L is the allowable leakage in gallons per hour
S is the length of pipe in feet
D is the nominal pipe diameter in inches, and
P is the average test pressure in psig

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

H. Pressure testing shall be performed in accordance with AWWA C-600 and C-605.

3.07 DISINFECTION OF POTABLE WATER PIPING

A. After the pressure test and prior to disinfecting, the lines shall be thoroughly flushed through hydrants or by other means as approved by the Engineer.

B. In accordance with AWWA C651-14, minimum flushing velocity shall be 3 ft/s.

C. The Contractor shall furnish required materials and apparatus and perform the work of disinfection.

D. All water piping shall be cleaned and disinfected in accordance with AWWA C-651-14 and one of the following:

1. Liquid Chlorine (gas). Cl2 gas conforming to ANSI/AWWA B301shall be used only in combination with gas-flow chlorinators and ejectors and under the direct supervision of trained/certified chlorine operators.

2. Liquid sodium hypochlorite by means of a suitable solution feed machine or pump. Sodium hypochlorite storage conditions and durations shall be controlled to minimize deterioration.

3. Calcium hypochlorite as tablets, granules. Tablets or granules shall be placed in the water line during construction. The water line shall be filled, carefully, with potable water to produce a uniform solution. Tablets designed for swimming pool disinfection shall not be used.

E. Four methods of disinfection shall be acceptable; tablet/granular, continuous feed, slug, and spray.

1. Tablet/granular chlorine initial dose shall be 25 mg/L.

2. Continuous feed chlorination gives a 24-hour residual of not less that 10mg/L.

3. Slug method gives a 3-hour exposure of not less than 200 mg/L of free chlorines.

4. Spray method shall give a 30-minute exposure of not less than 200 mg/L of free chlorine.

F. Following disinfection, all treated water shall be flushed from the lines at their extremities until the replacement water throughout the lines shall, upon testing, be chemically and bacteriologically acceptable.

1. Two or more successive sets of samples taken at 16-hour intervals, or two successive samples taken 15 minutes apart after a 16 hour sit time in the line, shall

indicate microbiologically satisfactory water before the lines are placed into service

a. Samples shall be collected every 1,200 feet plus one set from each end of the line.

2. Should the initial treatment prove ineffective, the disinfection shall be repeated until the test shows acceptable results.

3. The disposal of heavily chlorinated water shall be coordinated with the Owner and regulatory agencies. The heavily chlorinated water may require the addition of a dechlorinating chemical prior to release to a storm sewer or the environment. The dechlorinating method shall be approved by the Owner and Engineer. The heavily chlorinated water shall not be released to sanitary sewers without permission from the Owner of the sanitary sewer system.

G. All testing shall be done by a laboratory acceptable to the public authority having jurisdiction, and all costs shall be paid for by the Contractor.

PART 4 SPECIAL PROVISIONS

4.01 PIPING SCHEDULE

A. The following letter designations are used in the Piping Schedule:

Material Designation:

DIP - Ductile Iron Pipe

Schedule:

Service	Size	Pressure Class Thickness Class	Material	Remarks
City Water (Potable)	24"	Class 52	DIP	Fully Restrained
City Water (Potable)	30"	Class 52	DIP	Fully Restrained

B. Schedules are not guaranteed to be complete. All piping shown on the Drawings or specified shall be furnished and installed by the Contractor whether or not listed in the above schedule.

END OF SECTION

SECTION 02556

FIRE HYDRANT ASSEMBLIES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing fire hydrant assemblies as specified herein, including 6-inch ductile cast iron pipe, valves and boxes, and fire hydrants.

B. All tees in water main shall be included under main line work.

1.02 SUBMITTALS

A. Submittals shall be in accordance with all requirements of Section 01300 and shall include:

1. Shop Drawings for review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Manufacturer's assembly drawings and parts list including model numbers and materials of construction.

2. Information for the record:

a. Operation and Maintenance Manual information.

PART 2 PRODUCTS

2.01 HYDRANTS

A. Fire hydrants shall comply with AWWA Specification C-502. Fire hydrants shall be Watermaster 5BR250 as manufactured by East Jordan Iron Works or American-Darling B62B-5 as manufactured by American Flow Control.

B. Hydrant shall have a minimum barrel diameter of 7 inches with a 5 inch compression opening with a 6 inch mechanical joint connection to hydrant lead. The main valve shall be of high grade rubber or neoprene not less than 5-1/4 inch in diameter.

C. Operating and nozzle cap nuts shall be pentagon shaped and shall measure 1-1/2 inch from point to flat. The operating nut shall open left, or counterclockwise.

D. Hydrants shall be furnished with two 2-1/2-inch diameter hose nozzles and one 5-inch diameter pumper nozzle. Nozzle diameter and thread shall be per local fire district standards. Pumper nozzle shall be provided with a Storz fitting compatible with 5-inch diameter coupled fire hoses as manufactured by Harrington, Inc., or approved equal. The Storz fitting shall be factory mounted. Add-on Storz fittings are not acceptable.

E. Hydrants shall be painted chrome yellow. Paint shall be of an approved industrial quality exterior enamel applied in two coats over one coat of red lead primer.

2.02 LEAD PIPE

A. The 6-inch ductile cast iron pipe used for hydrant lead shall be lined and coated as specified under Section 02555.

2.03 VALVE AND VALVE BOX

A. Six inch valves and valve boxes shall meet the requirements specified in Section 02557.

B. Valves shall have mechanical joints.

PART 3 EXECUTION

3.01 INSTALLATION

A. The hydrant lead, including the valve, shall be laid on firm ground and backfilled as specified in Section 02555. The length of hydrant lead shown on the Drawings is approximate only and may vary according to field conditions.

B. The base of the hydrant shall be set on two 4 inch by 8 inch by 16-inch solid concrete block, or 6 inch (minimum thickness) by 8 inch by 16 inch poured base of Class B concrete on undisturbed earth. The hydrant barrel shall be set plumb.

C. One cubic yard of pipe bedding shall be placed around the barrel of the hydrant between the end of the trench and the valve. The stone shall not be placed closer than 2-feet to the ground surface.

D. Restraining glands shall be used on the entire hydrant lead from the branch run of the main line tee to the hydrant.

E. Proper barrel lengths shall be used to extend hydrant assembly to finished grade. Barrel lengths may vary to accommodate finished grade.

F. Weep Hole Plugging

1. In areas of high groundwater table, seasonally within 3 vertical feet of the hydrant assembly base, all weep holes shall be plugged to eliminate groundwater contamination of the water system.

a. Weep holes shall be threaded and plugged with a stainless steel threaded plug. A welded plug is acceptable provided that the surface and plug are coated, prior to bury with an acceptable NSF61 certified paint.

b. Following plugging, the hydrant assembly shall be pressure tested up to the shutoff valve. Test pressure shall be 40psi for 1 hour. No allowable leakage/pressure loss shall be acceptable.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 02557

VALVES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing valves, valve boxes, floor boxes, extension stems, and appurtenances as specified, shown on the drawing.

B. Valves in hydrant assemblies are included in this Item.

1.02 SUBMITTALS

A. Submittals shall be in accordance with all requirements of Section 01300 and shall include:

1. Shop Drawings for review:

2. Drawings for Review:

   a. Manufacturer's assembly drawings and parts list including model number and materials of construction.

3. Information for the record:

   a. A certificate of compliance with AWWA C-509, or AWWA C-504 shall be submitted, if required by the Engineer.

   b. Certification of NSF approval.

PART 2 PRODUCTS

2.01 GATE VALVES

A. Gate valves shall be cast iron body, bronze mounted, AWWA C-509 resilient seat, nonrising stem type with mechanical joint ends.

B. Valves shall be furnished with an O-ring seal incorporating two rubber O-ring seals.

C. Valves shall be designed for 150 psi working pressure and shall be shop tested at 300 psi pressure, with the pressure held on the valve for at least one minute.

D. Unless specified otherwise, valves shall be designed to open in counterclockwise directions with an arrow indicating the direction for opening. Wrench nuts shall be 2 inch square.

E. Iron parts shall be painted before leaving the shop with two coats of acceptable high grade bituminous paint or epoxy paint.

F. Bolts and nuts on buried valves shall be a low alloy steel cathodic to the valve body and having a minimum yield strength of 45,000 psi. All other nuts and bolts shall be low carbon steel conforming with the mechanical and chemical requirements of ASTM A-307, Grade B.

G. Gate valves shall be American Flow Control Series 2500, Clow Water Systems Co. F6100, East Jordan Iron Works Flowmaster MJxMJ, or Mueller Industries A-2360-20.

2.02 BUTTERFLY VALVES

A. Except as modified or supplemented herein, the butterfly valves and operators shall conform to the requirements specified in AWWA C-504.

B. The valves shall have an open/shut function in a buried condition. The valves shall be designed for a normal working pressure of 150 psi with a maximum pressure differential of 150 psi. The design wide open valve flow shall be for free discharge in either direction.

C. The valve bodies shall be cast iron conforming to ASTM A-48, Class 40, or ductile iron conforming to ASTM A-536, Grade 65-45 12. The ends shall either be Class 125 cast iron flanges with suitable adapters or mechanical joints conforming to ANSI 21.11.

D. The valve shafts shall be continuous, one-piece shaft type extending through the valve disc hubs. Shafts shall be of 304 stainless steel.

E. The valve disc shall be cast ductile iron with a 304 stainless steel seating edge.

F. The seats shall be of rubber of BUNA-N material and retained to the body of the valve by a stainless steel clamp ring.

G. The valve shall be equipped with a thrust bearing, other than the seat, to hold the disc in the center of the valve seat.

H. The operator shall be sized in accordance with AWWA C-504 and be designed for underground service. The operator gear shall be designed for a maximum pull-push of 25 pounds on a standard tee wrench. Traveling nut type operators are not acceptable.

I. Unless specified otherwise, valves shall operate in a counterclockwise direction to open the valve. Wrench nuts shall be AWWA 2 inch square. The operator and stem shall be enclosed by a valve box as specified herein.

J. Butterfly valves shall be Clow Water Systems 4500 Series, Golden Anderson GA AWWA C504, or Pratt Groundhog.

2.03 ACCESSORIES

A. Valve Boxes:

1. All buried valves shall be provided with valve boxes. Valve boxes shall be Tyler Union (USA ONLY) Model 6850 Two Piece 664-S or East Jordan Iron Works Model 8555 Two Piece 668-S.

2. All parts of valve boxes, bases, and covers shall be coated by dipping in bituminous varnish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Gate, Check and Butterfly Valves:

1. Valves shall be installed in their respective positions, free from distortion and stress. Connecting joints shall be as specified in Section 02555.

2. Where specified, the anode caps shall be installed on exposed bolts and nuts on valve.

B. Accessories:

1. Valve Boxes shall be installed in a plumb position and in alignment with the operating nut.

2. Extensions stems and stem guides shall be in alignment with operating nut and prevent binding and stresses on connecting pins.

PART 4 SPECIAL PROVISIONS

4.01 T-WRENCHES

A. The Contractor shall furnish 2 tee wrenches each 9 feet long and capable of engaging 2-inch square operating nuts.

END OF SECTION

SECTION 02600

PAVEMENTS, CURBING, AND WALKS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the construction of pavements as shown or scheduled on the Drawings, specified or directed.

B. This Section includes preparation of the base and subgrade construction of pavements and base courses to conform to new pavement courses, and other work and materials incidental to the construction of pavements, curbing, and walks.

1.02 OWNER'S STANDARDS AND SPECIFICATIONS

A. Street pavement disturbed by construction shall be restored in accordance with the Owner's present standards and specifications.

1.03 SUBMITTALS

A. Submittals shall be in accordance with all requirements of Section 01300 and shall include:

1. Shop Drawings for review:

a. Manufacturers' and suppliers' material certificates.

b. A sieve analysis (ASTM C 136) shall be furnished for each material source.

2. Information for the record:

a. Delivery tickets from the asphalt and aggregate suppliers shall be given to the inspector at the unloading site. Tickets shall include (as a minimum) name of source, date, type of material, and weight.

b. Test results and certificates.

PART 2 PRODUCTS

2.01 AGGREGATE BASE AND SURFACE

A. The aggregate shall be crushed limestone meeting the requirements of MDOT Table 902-1, Class 21AA or 22A.

2.02 RESERVED

2.03 ASPHALT EMULSIONS

A. The bond coat material shall be SS-1h or CSS-1h, and shall meet the requirements of MDOT Table 904-4 and 904-5.

B. The prime coat material, if required, shall be MS-Op and shall meet the requirements of MDOT Table 903-4.

2.04 BITUMINOUS AGGREGATE BASE AND ASPHALT CONCRETE

A. Bituminous Material - The asphalt cement shall be PG 58-28 performance grade (Design Temperature) and shall meet the requirements of MDOT Table 904-2.

B. Design Mix - Refer to MDOT Section 501.

1. The leveling course shall meet the requirements of MDOT 13A.

2. The wearing course shall meet the requirements of MDOT 13A.

2.05 RESERVED

2.06 PAVEMENT MARKING

A. Contractor shall provide temporary and permanent pavement markings equal to those markings that are removed from existing paved surfaces prior to commencement of the work unless scheduled on the drawings, specified, or as directed. See Ohio edit

B. Pavement markings shall be in accordance with the requirements of MDOT Item 811.

C. Pavement markings shall match existing or adjoining pavement markings.

PART 3 EXECUTION

3.01 COORDINATION

A. All soil subgrade under pavements, driveways, curbs, curb and gutter, and walks shall be compacted in accordance with Section 02200.

B. All service boxes, manholes, inlets and other structures shall be adjusted or reconstructed to the required grades in both new and resurfacing pavement areas.

3.02 PAVEMENT INSTALLATION

A. All construction shall be in conformance with applicable portions of MDOT Specifications, except as otherwise specified or called for herein.

B. Unless otherwise directed by Engineer all aggregate bases which are to receive bituminous courses shall be primed at a minimum rate of 0.30 gallons per square yard.

C. A tack coat at a rate of 0.05 to 0.8 gallon per square yard shall be applied to all existing pavements which are to be overlaid, and between subsequent courses when directed by the Engineer.

3.03 TRANSITION JOINTS FOR BITUMINOUS CONCRETE PAVEMENT OVERLAY

A. Types of Transition Joints:

1. Transition joints shall be either butt type or feathered type as directed by the Engineer.

2. Butt joints shall be used on State and Federal roads and main thoroughfares and feathered joints used elsewhere unless otherwise specified.

3. Butt Joints:

a. When a butt joint is called for on the Drawings or specified, the old surface shall be cut back for at least 3 feet to a depth of at least 1 inch for the full width of the joint and pavement installed.

b. A bituminous seal shall be placed on the finished surface at the junction of the new and old pavements.

4. Feathered Joint:

a. Feathered joints shall be constructed by manually raking the paving material to a smooth transition from the full depth material to the existing pavement surface.

b. Existing pavement surface shall be bond-coated to include the transition area.

c. Feathering shall be done by a workman skilled in the operation and shall be approved by the Resident Project Representative.

3.04 RESERVED

3.05 RESERVED

3.06 RESERVED

3.07 RESERVED

3.08 RESERVED

3.09 INSPECTION

A. Laboratory services shall be in accordance with the requirements of Section 01410 and shall include:

1. A compaction test on the subgrade, aggregate base, and each layer of asphalt shall be performed for every 300 square yards of material placed.

2. Asphalt Concrete:

a. Plant Certification - The laboratory shall certify or furnish recent certification (within one year) from 2018 that the plant meets State requirements.

b. Quality Control Testing - A sample of the mix shall be taken for each 200 cubic yard of bituminous material or fraction thereof delivered to the project. An extraction test AASHTO T164-70 and a mechanical analysis AASHTO T30-70 shall be performed on the mix samples.

3. Cast-in-Place Concrete:

a. Concrete shall be tested in accordance with Section 03300, Cast-in-Place Concrete.

3.10 PROTECTION

A. No heavy construction vehicle shall operate on any pavement, curbing, or walk after it has been installed.

B. Traffic shall be prohibited on newly installed asphalt pavement until it has cooled sufficiently to avoid marking.

PART 4 SPECIAL PROVISIONS

None

END OF SECTION

SECTION 02800

SODDING, SEEDING, AND MULCHING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes fine grading, seeding, and mulching areas designated on the Drawings, specified, or ordered.

B. The work consists of fine grading, furnishing and placing topsoil; seed; mulching material; and fertilizer; and watering seeded areas until growth is established.

C. The Contractor shall restore all grass areas damaged by his operations.

D. Unless otherwise specified herein or directed, work shall be in conformance with MDOT Section 816, Turf Establishment.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's project information for materials.

2. Information for the Record:

a. Submit to Resident Project Representative:

1) Invoices indicating the weight, brand, and composite analysis of fertilizer used on the project.

2) Bag tickets indicating weight and composition of all seed used on the project.

PART 2 PRODUCTS

2.01 RESERVED

2.02 SEED

A. Seed mixtures shall be in conformance with the requirements of MDOT Tables 816-1 and 917-1, Mixture TUF, unless otherwise specified in the Special Provisions.

2.03 FERTILIZER

A. Commercial fertilizers shall be from a dealer or manufacturer whose brands and grades are registered or licensed by the State of Michigan, Department of Agriculture. The content of nutrients shall be 12-12-12, unless otherwise approved by Engineer.

2.04 MULCHING MATERIAL

A. Mulching material shall be straw, wood fiber or compost reasonably free of weed seed, and other foreign materials, conforming to MDOT Section 917.15A.

2.05 RESERVED

2.06 TOPSOIL

A. Topsoil furnished by the Contractor shall be as specified in Section 02200.

PART 3 EXECUTION

3.01 FURNISHING AND PLACING TOPSOIL

A. Areas from which the top layer of soil has been removed or disturbed shall be recovered with a minimum of 4 inches of recompacted topsoil placed in conformance with MDOT Section 816.03A.

3.02 PREPARATION

A. The operating of finish grading and sowing shall not be performed when the ground is frozen or muddy.

B. Areas to be Seeded:

1. Unless otherwise shown on the Drawings or specified in Part 4, all areas of disturbed soil on the project site shall be seeded.

2. The area to be seeded shall be prepared in accordance with Section 02200.

3. Fertilizer shall be applied at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients in equal proportions of Nitrogen, Phosphoric Acid, and Potash. Either dry or liquid fertilizer may be used and shall be distributed in an even pattern over the specified area, then thoroughly disked, harrowed, or raked into the soil to a depth of not less than 1 inch.

3.03 INSTALLATION

A. Seeding:

1. The seed shall be mixed thoroughly and sown evenly at a rate specified by MDOT. The seed mixture may be sown dry or hydraulically unless directed otherwise in Part 4 of this Section.

2. The seed mixture shall be applied when the soil is in a workable condition and shall be raked into a depth of approximately 1/4 inch.

3. Seed shall be sown only between the dates of May 1 and October 15, unless otherwise permitted by the Engineer.

B. Mulching:

1. Within 24 hours after an area has been seeded it shall be mulched in conformance with one of the following specified methods as designated in Part 4:

2. Mulch:

a. Mulching with hay or straw shall be in conformance with mulching requirements of MDOT Sections 816.03E, F, and G except that in front of residences the mulching material shall be kept in place by an approved nontracking adhesive or other approved method in lieu of the specified asphalt emulsion.

b. Matting shall be used on all slopes greater than 10:1. Matting used for mulching shall be placed in conformance with MDOT Section 816.03H.

C. Seeded areas shall be watered and maintained as specified below until they are established.

1. The seed bed shall be thoroughly watered, as soon as the seed is covered.
2. Water shall be applied by a hydro-seeder or water tank under pressure with a nozzle producing a spray that will not dislodge the mulching material.
3. Water applications shall be made at least once a week, provided significant rainfall has not occurred within the weekly period.
4. The rate of application shall be 240 gallons per 1,000 square feet
5. The Contractor shall keep all seeded areas, including the subgrade, thoroughly moist for two weeks after seeding. After the two-week period, the Contractor shall water the seedbed as specified above.
6. Mulch and matting areas shall be maintained until all work on the Contract has been completed and accepted.
7. The seeded area shall be mowed once at an approximate height of 6 inch as directed by the Engineer to control excess growth, including weeds.
8. Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, or other causes. The soil in these damaged seeded areas shall be restored to the condition and grade existing prior to application of mulch or matting, and restored areas shall be relimed, refertilized, and reseeded. Where necessary, the mulch or matting shall be completely replaced.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing, placing, finishing, and curing cast-in-place concrete. Miscellaneous materials required for concrete construction are included.

B. Anchor bolts and other cast-in items are furnished under other Sections.

C. The Contractor, before commencing work, shall examine all adjoining work on which this work is dependent for proper installation and workmanship according to the intent of this specification, and shall report to the Engineer any condition which prevents this Contractor from performing first class work.

D. Laboratory services for quality control shall be furnished in accordance with requirements of Section 01410.

E. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Concrete mix designs including substantiating data and test records. Concrete Mix Design, Proportioning.

b. Product literature for admixtures, curing compounds, and miscellaneous materials.

c. Locations of construction and control joints not shown on Drawings, and proposed changes in locations.

d. Material certifications.

e. Aggregate gradation and percentages of deleterious substances.

f. Batch plant certification.

2. Information for the Record:

a. Manufacturer's application instructions for miscellaneous materials.

b. Quality control test reports.

c. Slab profile report.

B. Copy of concrete delivery ticket shall be presented to Resident Project Representative for each batch. Delivery ticket shall indicate:

1. Name of ready-mixed company and plant designation.

2. Truck number.

3. Concrete class.

4. Quantity of concrete.

5. Date.

6. Time when batch was loaded.

7. Type and name of admixtures.

8. Actual batch weights of cement, fly ash, aggregates, and water.

9. Location of pour and time of unloading shall be added to the ticket at site.

1.03 QUALITY ASSURANCE

A. Batch Plant:

1. Batch plant shall be central batch plant with automatic or semi-automatic control. Concrete may be mixed using either central-mixed, shrink-mixed, or truck-mixed methods. If concrete is shrink-mixed or truck-mixed, the truck and concrete shall conform to ASTM C-94.

2. Batch plant shall be certified by the Department of Transportation, National Ready Mixed Concrete Association (NRMCA) or an independent certification using NRMCA "Check list for Certification of Ready Mixed Concrete Production Facilities" executed and certified by independent Professional Engineer registered in state of project site. Evidence of current certification shall be submitted.

B. Pre-installation Conferences:

1. Before beginning concrete work, Contractor shall hold a meeting to review detailed requirements for preparing concrete mix designs and to determine proper procedures for concrete construction. A representative of Contractor, testing laboratory, concrete producer, concrete pumping contractor, and Engineer shall be in attendance.

2. Contractor shall submit for Engineer review a plan showing the locations of all proposed construction and control joints, which are not shown on the construction Drawings, and a schedule that incorporates the alternating pour sequences required to allow for strength gain and control of volumetric shrinkage changes.

3. When dry-shake floor hardener or metallic topping is specified, manufacturer's representative shall instruct Contractor on proper equipment and application procedures.

C. Concrete work shall be in accordance with the current edition of the following codes, standards and specifications:

1. American Concrete Institute (ACI).

2. "Manual of Standard Practice", Concrete Reinforcing Steel Institute (CRSI).

1.04 DELIVERY AND HANDLING

A. Concrete shall be delivered in accordance with ASTM C94 except the time limit for discharging of concrete during hot weather shall be reduced as specified.

B. Concrete shall be delivered in agitating trucks or in mixing trucks operating at agitating speed.

1.05 ENVIRONMENTAL CONDITIONS

A. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow, or when inclement weather is imminent.

B. Cold Weather:

1. Cold weather concreting procedures per "Cold Weather Concreting," ACI 306R, shall be followed whenever any one of the following conditions occur or are expected to occur:

   a. The air temperature is below 40 degrees F at the time of concrete placement.

   b. The average daily air temperature is below 40 degrees F for three consecutive days immediately prior to the day of concrete placement.

   c. An average daily air temperature below 40 degrees F is foreseen or occurs during any day of the specified concrete curing period.

2. For purposes of the paragraphs above, the average daily temperature is defined as the arithmetic mean of the highest and lowest temperature during the period from midnight to midnight. All air temperatures are to be measured at the project site.

C. Hot Weather:

1. Hot weather concreting procedures per "Hot Weather Concreting," ACI 305R, shall be followed whenever any one of the following conditions occur or are expected to occur:

   a. The air temperature is above 90 degrees F at the time of concrete placement.

   b. Whenever conditions of concrete temperature, air temperature, wind velocity, and relative humidity combine to cause flash set, excessively low slump, cold joints, plastic shrinkage cracking, or otherwise impair the quality of concrete,

2. When the evaporation rate of bleed water exceeds 0.1 pounds per square foot per hour, steps shall be taken to prevent plastic shrinkage cracking. Evaporation rate shall be determined by the method presented in "Hot Weather Concreting," ACI 305R.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement - ASTM C150 Type I or II, unless indicated otherwise. All cement shall be from the same mill. Cement for Class A-2 concrete shall contain less than 8 percent tricalcium-aluminate (C3A).

B. Coarse Aggregate - Aggregates for normal weight concrete shall be crushed limestone conforming to ASTM C33, Class 4S. Aggregates for lightweight concrete shall meet the requirements of ASTM C330. Aggregates shall satisfy all quality requirements specified therein (i.e. grading, limits on deleterious substances, etc.).

C. Fine Aggregate - ASTM C33.

D. Fly Ash - ASTM C618, Class C or Class F, including supplementary chemical requirements and supplementary physical requirements, except loss-on-ignition shall be less than 5 percent. The use of fly ash shall be in accordance with "Use of Fly Ash in Cement (ACI-232.2R").

E. Silica Fume - ASTM C1240.

F. Ground Granulated Blast Furnace (GGBF) slag shall be in accordance with ASTM C989 Grade 100 or 120. Slag for Class A-1 concrete shall contain less than 12 percent tricalcium-aluminate (C3A) and slag for Class A-2 concrete shall contain less than 8 percent tricalcium-aluminate (C3A).

G. Admixtures - The use of all admixtures shall be in accordance with "Chemical Admixtures for Concrete (ACI 212.3R"), and "Guide for the Use of High Range Water Reducing Admixtures in Concrete (ACI 212.4R)."

1. Air entraining - ASTM C260.

2. Water-reducing - ASTM C494.

3. Accelerator - ASTM C494, Type C or E, admixture shall be non-corrosive as verified by long-term accelerated corrosion testing by an independent laboratory.

4. Anti-washout admixture - Master Builders "Rheomac UW450", or equal.

5. Only those admixtures expressly stated by the manufacturer as being chloride-free shall be used.

6. The maximum water-soluble chloride ion content, expressed as a percentage by weight of the cement, contributed from all concrete ingredients shall not exceed 0.10 percent for non-prestressed concrete structures. Written certification of chloride ion content shall be submitted. Testing for Chloride Ion content shall conform to ASTM C1218.

7. If more than one admixture is used, the admixtures shall be compatible with each other and shall be incorporated into the concrete mix in correct sequence and timing so that desired effects of all admixtures are realized, and harmful effects are avoided.

8. Air-entraining and chemical admixtures shall be incorporated into the concrete mix in a water solution. The water so included shall be considered to be a portion of the allowed mixing water.

H. Water shall conform to ASTM C94. Mixing water, including that contributed by aggregates and admixtures, shall be clean, and free from injurious amounts of oils, acids, alkalis, organic materials, chloride ions, or other substances that are deleterious to concrete or reinforcement. Non-potable water shall not be used.

2.02 ACCESSORIES

A. Curing Compound - Compound shall be membrane-forming, liquid applied, non-yellowing, VOC-compliant, water-based acrylic polymer resin conforming to ASTM C309, Type 1 and ASTM C1315, Type 1, Class A. The compound shall include sealing and dustproofing properties. Minimum solids content shall be 25 percent. Compound shall not permit a moisture loss in excess of 0.40 kilograms per square meter (0.082 pounds per square feet) in 72 hours. Sodium silicate based products are not acceptable. Compound shall be Dayton Superior "Cure & Seal 1315 J22WB", SpecChem, LLC. "Cure & Seal WB 25", L&M Construction Chemicals, Inc. "Lumiseal WB Plus" or equal. Curing compound in potable water treatment plant construction shall be non-toxic and free of taste and odor.

2.03 RESERVED

2.04 RESERVED

2.05 CONCRETE MIXES

A. Contractor shall design and be responsible for the performance of all concrete mixes. Mixes shall have the required quality, consistency, and workability to permit concrete to be readily worked into forms and around reinforcement without segregation or excessive bleeding. Hardened concrete shall develop all characteristics required by Contract Documents

B. Proportioning:

1. Concrete mixes shall be proportioned to maximize durability and water tightness. To this end the total water content shall be reduced to the lowest practical amount that is consistent with placing and consolidation methods. Water reducing and high range water reducing admixtures shall be used as required to maintain workability. Specified water/cementitious ratio shall not be exceeded.

2. Concrete proportions shall comply with ACI 211.1, ACI 301, ACI 318 and for the environmental components of the work ACI 350.

a. Proposed mix designs proportioned by field test data or trail mixes shall be accompanied by a complete standard deviation analysis and calculations for the required average compression strength F`cr. Test records used for determining standard deviation and average strength shall have been made within the past 12 months. These test records must represent materials, quality control procedures and conditions similar to those expected, and changes in materials and proportions within the test records shall not have been more restricted than those for the proposed work.

b. Proportioning by empirical methods on basis of water/cement ratio is not permitted.

c. Concrete mix proportions are subject to Engineer's approval.

C. Design mixes shall have following requirements:

1. Three normal weight concrete mixes are generally required; Class A-1, A-2and Class B. Concrete mixes shall be as follows:

	Class A-1	Class A-2 (wastewater)	Class B
28-Day Compressive Strength f'c (psi)	4500	4500	3000
Maximum Water/Cementitious Ratio:	0.44	0.42	.66
Minimum Cementitious Content (Lbs/CY)	600	650	480
Maximum Cementitious Content (Lbs/CY)	800	800	650
Slump (Inches)	See below	See below	See below

For calculating water/cementitious ratio of the mix, the weight of the water shall be that of the total free water in the mix, which includes the mixing water, the water in any admixture solutions, and any water in the aggregates in excess of that needed to reach a saturated surface dry condition.

2. Concrete placed under water shall contain an approved anti-washout admixture and shall contain a minimum of 600 pounds of cement per cubic yard. Fly ash or GGBF slag shall not be used in the concrete mix.

D. Slump:

1. When superplasticizer is not included in the mix, slump shall be 2-4 inches.

2. When superplasticizer is included in the mix, the maximum slump measured upon delivery to the construction site shall be 3 inches. Superplasticizer shall be added at the site after verification of slump to increase slump to the desired amount.

3. Tolerance of 1 inch above the maximum specified slump will be permitted for one batch in any five consecutive batches.

4. Concrete of lower slump than specified may be used provided it is properly placed and consolidated. Field adjustment of slump by addition of water is not permitted.

E. Air Content:

1. All concrete shall be air entrained unless specified or noted otherwise on the Drawings.

2. Concrete to be air-entrained shall have an air content as schedule below, unless specified otherwise:

Nominal maximum size of coarse aggregate (inch)	ASTM C-33 Aggregate Size number	Total air content percent by volume
3/8	8	7.5
1/2	7	7.0
3/4	67	6.0
1	57	6.0
1-1/2	467	5.5

3. Allowable deviation from specified air content is plus or minus 1 percent.

4. Interior floor slab specified to receive a trowel finish shall not be air entrained. Maximum air content shall be 3 percent.

5. Air entrainment is not required for Class B concrete.

F. Coarse Aggregate Size:

1. Nominal maximum size of aggregate shall not be more than one-fifth of narrowest dimension between side forms, one-third of depth of slabs, nor three-fourths of minimum clear spacing between reinforcing bars.

2. Coarse aggregate shall be largest size consistent with placing methods and specified constraints. Minimum coarse aggregate shall be Size Number 57, unless smaller size is required by dimensional or reinforcement spacing constraints.

G. Cementitious Material:

1. The cementitious mixture shall contain cement and either fly ash or GGBF slag, but not both.

2. When fly ash is used in the concrete mixture, it shall comprise between 15 to 25 percent of the total cementitious mixture. When slag is used in the concrete

mixture, it shall comprise between 25 to 50 percent of the total cementitious mixture. The percentages are based on weight of the total cementitious mixture.

3. For concrete in contact with wastewater, Class A-2, the cementitious design mixture shall consist of ASTM C150 Type II cement and slag or ASTM C150 Type II cement and Class F fly ash. Alternately, ASTM C150 Type I cement and Class C fly ash may be used provided the design cementitious mixture is tested per ASTM C1012 to have 0.10 percent or less expansion in 6 months. The test results shall be submitted with the proposed concrete mix design.

4. Air content for concrete containing fly ash shall be closely monitored and the dosage of air-entraining admixture shall be modified as required.

2.06 CONCRETE PRODUCTION

A. Ready-mixed concrete is to be used unless otherwise specified. It shall be batched, mixed, and transported in accordance with ASTM C94.

B. Admixtures other than air-entraining admixture shall not be added without Engineer's written approval.

C. Admixtures shall be charged into mixer as solutions and shall be measured by means of acceptable dispensing device. If two or more admixtures are used, they shall be added separately. Admixtures shall be used in accordance with manufacturer's instructions.

D. During cold or hot weather conditions, special precautions, as specified in ACI 306R or ACI 305R, respectively, shall be taken during batching, mixing, and curing.

2.07 STORAGE OF MATERIALS

A. Cement shall be stored in weathertight containers.

B. Aggregate stockpiles shall be arranged to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates. Frozen or partially frozen aggregates shall not be used.

C. Sand stockpiles shall be allowed to drain to ensure a relatively uniform moisture content throughout the stockpile.

D. Admixtures shall be stored in a manner to prevent contamination, evaporation, freezing, or damage. Admixtures in the form of suspensions or nonstable solutions shall be agitated to assure thorough distribution of ingredients. Liquid admixtures shall be protected from freezing and from temperature changes which would adversely affect their characteristics.

PART 3 EXECUTION

3.01 COORDINATION

A. Reinforcement, sleeves, inserts, anchors, and embedded items shall be accurately placed, supported, and tied prior to concrete placement. Other trades and contractors required to furnish embedded items shall be given ample notice of concrete placement. Reinforcement and embedded items shall be subject to review of Resident Project Representative prior to placing concrete.

B. Contractor shall notify Resident Project Representative a minimum of 24 hours before placing concrete, excluding non-working days.

C. Concrete shall be placed only between hours of 8:00 a.m. and 6:00 p.m. unless otherwise permitted. Concrete shall not be placed after 12:00 noon on last working day of week.

3.02 PREPARATION

A. Hardened concrete and foreign materials shall be removed from inner surfaces of conveying equipment.

B. Formwork shall be completed and snow, ice, and water shall be removed from forms. Before placing reinforcing steel or concrete, the surfaces of the forms shall be covered with an acceptable coating material, or form liner may be used.

C. The space to receive concrete shall be free of laitance, dirt, and other debris. Laitance shall be removed by wire brushing.

D. Reinforcement and embedded items shall be checked for proper placement and adequate support. All reinforcement at the time concrete is placed, shall be free of mud, oil, or other materials that may adversely affect or reduce the bond. Aluminum conduits or pipes shall not be embedded in concrete unless approved by the Engineer and effectively coated to prevent aluminum-concrete reaction.

E. Preparation of grade shall be as specified for slabs. Concrete shall not be placed on frozen ground. There shall be no standing water on the subgrade, nor any muddy or soft spots when the concrete is placed.

F. A final detailed inspection of the foundation, construction joints, forms, waterstops, embedment's, reinforcements, and other items of the placement shall be made immediately before the concrete is placed.

3.03 PLACING CONCRETE

A. Conveying:

1. Concrete shall be handled from mixer to place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will ensure that required quality of concrete is maintained. Conveying systems shall not impair the strength, slump, or air content of the concrete. Concrete shall be placed and consolidated prior to initial set, and in no case more than 1-1/2 hours after the cement is added to the mix.

2. Chutes shall be metal (except aluminum), or wood with metal lining and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-feet long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.

3. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled to prevent segregation. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 inch.

4. Concrete shall not be permitted to drop more than 4 feet freely, or through a cage of reinforcing steel, from conveying device. Concrete shall be deposited through drop chutes, elephant-trunks, or tremies as required. Temporary openings in wall or column forms may be used to limit the free fall of concrete to less than four feet. The openings should be spaced no more than six to eight feet apart.

5. Concrete shall not be conveyed through pipes made of aluminum or aluminum alloy.

B. Depositing:

1. Concrete shall be deposited continuously or in layers of such thickness that no concrete will be deposited which has hardened sufficiently to cause planes of weakness within the sections. No interruption in concrete placement shall exceed 30 minutes to avoid cold joints in the structural elements being placed. Alternate placing equipment shall be immediately available for use in the event that the primary placing equipment or system breaks down.

2. Placing shall proceed at such a rate that concrete which is being integrated with fresh concrete is still plastic.

3. Concrete which has partially hardened or has been contaminated shall not be deposited.

4. Placing of concrete for supported elements, such as beams and elevated slabs, shall not begin until supporting elements, such as columns and walls, have cured for a minimum of 7 days, unless the concrete has attained 80 percent of the specified design compression strength or the shoring for the supporting elements has been designed to carry the weight of the supported elements and their construction load.

5. Concrete shall be placed continuously between construction, isolation, and expansion joints. Where joints are spaced greater than 25 feet apart the placing of concrete adjacent to previously placed concrete shall not begin until 48 hours after completion of previous placement, unless otherwise noted. Concrete shall be deposited as nearly as practical in its final position and shall be carried up evenly in forms to avoid segregation due to rehandling or flowing. Layers shall not exceed 24 inches. Concrete shall not be permitted to flow laterally in forms.

6. The temperature of the concrete mixture immediately before placement shall be between 50 degrees F and 90 degrees F, except as provided under cold weather and hot weather concreting.

C. Consolidating:

1. Concrete shall be consolidated by vibrating, so that concrete is thoroughly worked around reinforcement and embedded items, and into corners and angles of forms, eliminating air and stone pockets. Vibrators shall extend into underlying layers to bond two layers together. To avoid excessive pressure on the forms, the vibrator should penetrate no more than two feet into the underlying layer.

2. Vibrators shall be the largest size and most powerful that can be used properly in the work, as described in "Recommended Practice for Consolidation of Concrete" (ACI 309R). A minimum of one spare operable vibrator shall be available on site. Mechanical high frequency vibrators with a minimum frequency of 8,000 revolutions per minute are preferred for consolidation of concrete within the forms.

3. Vibrators shall not be used to transport or drag concrete within forms. Vibrators shall be inserted and withdrawn from the concrete slowly.

4. Vibrators shall be inserted in the fresh concrete at points approximately 18 inches apart or as recommended by the vibrator manufacturer. The vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

D. Defective Concrete:

1. Defective concrete is defined as concrete in place which does not conform to specified design strength, required percent air, shapes, alignments and elevations, as shown on the Drawings and/or which presents faulty surface areas. Evaluation and acceptance of concrete shall conform to ACI 318 and as determined by Engineer.

2. All defective concrete shall be removed and replaced in a manner meeting with the Engineer's approval. Should surface imperfections occur, they may be patched at the discretion of, and in a manner satisfactory to the Engineer. The Engineer reserves the right to require complete removal and replacement of such defective Work should the patching fail to satisfactorily restore the required quality and appearance of the Work. All such Work shall be performed at the Contractor's expense, without extension of time.

3. If for any reason, in the opinion of the Engineer, the testing of any section of the completed structure is necessary, a superimposed load shall be applied by the Contractor and the test conducted in accordance with the current Building Code at the Contractor's expense irrespective of the results of such tests. In cases where failure is declared, the Engineer shall have the authority to order the defective construction removed. All expense of removing such defective construction and substituting new construction, including expense of removing and replacing the Work of others, or protecting and repairing the Work of others, shall be borne by this Contractor.

3.04 JOINT INSTALLATION

A. Construction Joints:

1. Construction joints shall not be spaced further apart than 60 feet, unless noted otherwise. Where construction joint spacing exceeds 25 feet concrete placement shall be alternated so that adjacent sections are placed a minimum of 48 hours apart to allow for volumetric change of adjacent pours due to shrinkage and to help minimize cracks. Joints shall be located where they will least impair the strength, watertightness, and architectural design of the finished structure. Joint types and locations shall be subject to Engineer's approval. Construction joints shall not be located less than 5 feet from any other joint to which they are parallel.

2. Joints in walls and columns shall be placed at the tops of footings and mat foundations, unless shown otherwise. Joints should be made perpendicular to the main reinforcement where practical.

3. Joints shall be constructed straight by means of a temporary straight edge or rustication strip placed in forms. Joints shall be perpendicular to reinforcement.

4. Reinforcement shall be continuous across construction joints unless otherwise indicated. Unless otherwise specified or shown on Drawings, longitudinal keys at least 1-1/2 inches deep by 3-1/2 inches wide shall be provided in all joints in walls, and between walls and slabs or footings.

5. Surface of concrete shall be thoroughly cleaned and laitance shall be removed by wire brushing prior to placing adjoining concrete.

6. At all vertical joints in new concrete and in new against previously existing concrete, and wherever else called for on the Drawings, bonding adhesive paste shall be applied per the manufacturer's directions.

7. At all horizontal joints in new concrete and in new against previously existing concrete, and wherever else called for on the Drawings, bonding grout shall be applied in a 2-inch-thick layer.

B. Expansion and Isolation Joints:

1. Expansion and isolation joints shall be located and constructed as shown. Generally, joints shall be located at the perimeter of slabs-on-grades and other locations shown. These joints shall have filler material and have exposed faces sealed.

2. Reinforcement and other embedded metal items shall not extend continuously through expansion or isolation joints unless shown otherwise.

3. Unless polystyrene foam boards are called for on Drawings, premolded type joint fillers shall be installed for expansion joints in accordance with manufacturer's instructions. Joint filler shall be accurately placed and secured. Fillers for each joint shall consist of as few pieces of material as possible. Pourable or non-sag joint sealants per specification Section 07900 shall be placed in top or face of joints, as applicable, per manufacturer's instructions. All joints in tanks and within buildings shall be sealed unless otherwise shown. Where called for on the Drawings, exterior joints in or around walks and pavement shall be sealed.

C. Control Joints:

1. Unless indicated otherwise on the Drawings, control joints in slabs shall be located at a maximum spacing of 30 times the slab thickness in both directions with a maximum aspect ratio not to exceed 2 to 1. These joints shall preferably be located on column lines with joints also located between column lines if required to satisfy maximum spacing. Driveways and sidewalks shall have control joints spaced at intervals approximately equal to the slab width. Drives and walks wider than 12-feet shall have longitudinal and transverse joints at 12-feet maximum spacing. All control joints shall be continuous, not staggered or offset. Control joints shall not be located in liquid containing or conveying structures, such as tank, channels and etc.

3.05 FINISHING OF FORMED SURFACES

A. Surface defects shall be patched. Patching procedures shall be as follows:

1. Honeycombed and other defective concrete shall be removed to sound concrete. Cut or chip edges perpendicular to surface or slightly undercut; featheredging is not permitted. Area to be patched and surrounding area within at least 6 inches shall be dampened to prevent absorption of water from patching mortar.

2. Bonding grout consisting of 1-part cement and 1-part fine sand passing a No. 30 mesh sieve mixed to the consistency of a thick cream, shall be thoroughly brushed into surface immediately prior to applying patching mixture.

3. Patching mixture shall be composed of same proportions as used for concrete except that coarse aggregate shall be omitted and mixture shall not consist of more than 1-part cement to 2-1/2 parts sand by damp loose volume. Mixing water shall be no more than necessary for handling and placing. Patching mixture shall be prepared in advance and allowed to prehydrate with frequent manipulation with trowel, until stiffest consistency that will permit placement is obtained.

4. Where concrete is exposed to view, color of patching mixture shall be adjusted to match surrounding concrete by substituting appropriate amount of white cement for gray cement. Proper color shall be determined by trial patches.

5. Patching mixture shall be applied before bond coat begins to lose water sheen. Patching mixture shall be thoroughly consolidated and struck off so as to leave patch slightly higher than surrounding surface. Patch shall be left undisturbed for one hour after which time it shall be finished with metal tools. Patched area shall be moist cured for not less than 7 days.

B. Tie holes shall be patched as follows:

1. The holes shall be plugged, unless stainless steel noncorrosive or acceptably coated ties are used, as approved by Engineer.

2. Tie holes shall be cleaned and dampened prior to patching with a non-metallic, non-shrink grout. Patching material shall be packed solid into hole.

3. Contractor may substitute alternate materials and procedures subject to the approval of Engineer. These materials shall be applied in accordance with manufacturer's written recommendations wherever applicable.

C. Stains, rust, efflorescence, and surface deposits on exposed concrete shall be removed by methods acceptable to Engineer.

D. After removal of forms, the surface of concrete shall be given one or more of the finishes specified below as scheduled in the Finishing Schedule of this specification.

1. Rough Form Finish - Fins exceeding 1/8 inch in height shall be removed. Otherwise surfaces shall be left with texture imparted by forms.

2. Smooth Form Finish - The form facing material with or without form-liner shall produce a smooth, hard, uniform texture in the concrete. The type of facing material or form-liner selected is dependent upon the type of smooth finish desired and shall be approved by the Engineer. Tie holes and defects shall be patched. All fins shall be completely removed.

3. Special Architectural Finishes - This shall be produced in accordance with Section 6 of ACI 301R.

4. Smooth Rubbed Finish - The smooth rubbed finish shall be produced on a concrete with smooth form finish as specified above.

a. Forms shall have been removed and patching completed as soon after placement as possible without damaging or jeopardizing structure.

b. Finishing shall be performed no later than the day following form removal.

c. Surfaces shall be thoroughly wetted and rubbed with carborundum brick or other abrasive until form marks, fins, and irregularities are removed and uniform color and texture are produced. Cement grout shall not be used.

E. Finishing of Related Unformed Surfaces:

1. Tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after placement and shall be floated to texture consistent with that of adjacent formed surface. Where smooth rubbed finish or grout cleaned finish is specified, finish shall continue uniformly across unformed surfaces.

3.06 SLAB INSTALLATION

A. Preparation - Subgrade supporting slabs shall be well drained and of adequate and uniform load bearing capacity. Subgrade shall be free of frost before concrete is placed. Subgrade shall be moist at time of placement. Ground may be dampened with water, but there shall be no standing water on subgrade, nor muddy spots.

B. A minimum of 1/4 inch per foot slope shall be provided for exterior slabs, driveways, and walks. Driveways and walks can be pitched to one side or crowned along the longitudinal centerline with drainage to both sides as most suitable to surrounding drainage pattern.

C. Concrete shall not be deposited more rapidly than it can be spread, straight-edged, and darby or bull-floated. These later operations shall be completed before bleed water collects on surface. Rakes shall not be used for spreading concrete to avoid segregation. Slabs shall be consolidated by internal vibrators of high frequency and low amplitude, or vibrating screeds.

D. Construction joints shall not be spaced further apart than 60 foot in both directions. Where construction joint spacing exceeds 25 feet concrete placement shall be alternated, in a strip or checkered fashion, so that adjacent sections can be placed a minimum of 48 hours apart to allow for volumetric change of adjacent pours due to shrinkage and to help minimize cracks.

E. Control joints in slabs shall be located at a maximum spacing of 30 times the slab thickness, in both directions, with a maximum aspect ratio not to exceed 2 to 1, unless noted otherwise. These joints shall be located on column lines where practical. Driveways and sidewalks shall have control joints spaced at intervals approximately equal to the slab width. Drives and walks wider than 12-feet shall have longitudinal and transverse joints at 12-feet maximum spacing. All control joints shall be continuous, not staggered or offset, where practical. Saw-cutting of control joints shall be performed with "Soff-Cut" saw after final finishing as soon as the concrete surface is firm enough not be torn or damaged by the blades and prior to the application of curing compound. In any case, saw-cutting of joints shall be done within two hours after final finishing. Control joint shall be 1/8-inch-wide by one inch deep. Control joints shall not be located in liquid containing or conveying structures, such as tank, channels and etc.

F. Finishes:

1. Scratched Finish - After concrete has been placed, consolidated, struck off, and leveled, but prior to final set, surface shall be roughened with rakes.

2. Floated Finish - After concrete has been placed, consolidated, struck off, and leveled, surface shall not be worked further until ready for floating. Floating shall begin when bleed water sheen disappears and surface has stiffened sufficiently. Floating shall be performed with wood hand float or power float. During first floating, high spots shall be cut down and low spots shall be filled. Slab shall be refloated immediately to uniform sandy texture.

3. Troweled Finish - Surface shall first be float finished, followed by power trowel, and then hand troweled. Additional trowelings shall be performed after surface has hardened sufficiently. Final troweling shall be done when ringing sound is produced as trowel is moved over surface. Finished surface shall be free of trowel marks and uniformly smooth and hard. Dusting surface with cement is not permitted.

4. Broom Finish - Surface shall first be float finished and then given coarse texture by drawing broom over surface.

5. Non-Slip Finish - Non-slip abrasive aggregate shall be applied in accordance with manufacturer's instructions.

3.07 CURING

A. Beginning immediately after placement, concrete curing shall be initiated to protect the concrete from moisture loss and premature drying. Concrete shall be continuously cured for a minimum of 7 days. Tanks and other liquid-retaining structures shall be cured for minimum of 10 days. Elevated slabs, joists, and beams shall be cured for at least 14 days and as many additional days as necessary for tests to verify that the concrete has attained 90 percent of its specified design strength up to a maximum of 21 days. For the entire duration of the curing period, the concrete shall be protected from detrimental weather conditions as specified elsewhere in this Section.

B. Curing procedures for each type of concrete section shall be submitted and shall be in accordance with ACI 308, "Standard Practice for Curing Concrete," subject to the additional requirements specified herein.

C. Concrete surfaces not in contact with forms shall be cured by one of following procedures:

1. Ponding, fog spraying, or continuous sprinkling with water. Care shall be taken to avoid thermal shock from use of cold curing water or excessive evaporation rates. Alternate drying and re-wetting of slabs during curing shall be avoided to avoid hairline cracks at the surface.

2. Application of burlap or absorptive mats kept continuously wet.

   a. Burlap shall be clean and thoroughly rinsed in water before it is used.

   b. Burlap and absorptive mats shall be soaked as frequently as required to maintain continuously wet surface.

   c. Burlap and absorptive mats shall remain in place unwetted for minimum of 3 days after end of curing period to permit concrete to dry slowly.

3. Application of waterproof sheet material conforming to ASTM C171.

   a. Sheet material shall be placed over the wet surface of fresh concrete as soon as possible without marring surface. Material shall be placed flat without wrinkles.

   b. Sheet material shall cover all exposed surfaces and shall extend beyond edges of slab a distance of at least twice the thickness of the slab.

   c. Sheet material shall be lapped a minimum of 6 inches. Windrows of earth or wood shall be placed along edges and laps to seal joints and secure material from displacement by wind.

4. Application of approved curing compound.

   a. Curing compound shall be used only after receiving approval by the Engineer.

   b. Curing compound shall not be used on walls to receive smooth rubbed or grout cleaned finishes, prior to the completion of the application of these finishes. Curing compound maybe applied, at contractor discretion, over these finishes to complete the curing processes.

c. Curing compound shall not be used on surfaces to receive paint, liquid hardener, coatings, sealers, floor hardeners, tile, adhesives, or other materials requiring bond, unless positive measures are taken to remove it completely from the areas to receive bonded application.

d. Curing compound shall be placed in accordance with manufacturer's instructions after finishing, and immediately after water sheen has disappeared from concrete surface.

e. Exposed steel, keyways, or concrete to be surfaced shall be protected from curing compounds, unless the manufacturer of the surfacing material submits written documentation approving the use of their material on concrete on which the specific curing compound was applied.

f. Curing compounds shall not be used on surfaces to receive concrete toppings. Refer to Concrete Toppings Section 03510.

D. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by sun shall be minimized by maintaining forms continuously wet.

1. Forms shall be continuously sprinkled or covered with wet burlap.

2. If forms are loosened but not removed, water shall be made to run down inside of form by use of soaker hoses.

3. If forms are removed prior to completion of curing period, concrete shall be cured by one of the methods specified for concrete surfaces not in contact with forms.

3.08 RESERVED

3.09 HOT WEATHER CONCRETING

A. Hot weather concreting procedures including production, transportation, placement, protection, and curing shall be submitted for Engineer's review prior to onset of hot weather.

B. Concrete Production and Delivery - The temperature of the concrete at time of placement shall be maintained within specified temperature by any combination of the following:

1. Type III cement is prohibited.

2. The temperature of the aggregates shall be kept low by shading the aggregate piles or sprinkling the aggregate with water.

3. Concrete ingredients shall be cooled before mixing or flake ice shall be substituted for all or part of mixing water as required to reduce concrete temperature. Mixing shall continue until ice is completely melted.

4. Delivery of concrete shall be scheduled so that concrete is deposited as soon as practicable. Concrete shall be completely discharged within 1 hour after introduction of mixing water to cement.

5. Water reducing or retarding admixtures with shrinkage compensating cement shall be used in such quantities as recommended by the manufacturer.

C. Preparation - Steel forms, reinforcement, and embedment's shall be cooled to below 90 degrees F by means of spraying with water or other approved methods immediately prior to concrete placement.

D. Placing - Concrete shall be placed at lowest practicable temperature. Temperature of concrete as placed shall not cause difficulty from loss of slump, flash set, or cold joints and shall be between 75 degrees F and 90 degrees F and in no case shall exceed 90 degrees F.

E. Protection:

1. During hot weather conditions prior to the application of curing materials, the concrete being placed and finished shall be protected from damage due to rapid evaporation. Such protection shall be adequate to prevent premature crusting of surface or an increase in drying shrinkage and cracking. Such protection shall be provided by raising the humidity of the surrounding air by fog spraying, the use of wind breaks or sun shades, additionally reducing of the temperature of the concrete, scheduling placement during the cooler times of days or nights, reducing time between placement of concrete and start of curing, or any combination thereof.

2. Forms shall be covered and kept moist.

F. Curing:

1. Curing shall be performed by water methods only unless approved otherwise.

2. When the use of waterproof sheet material is approved for hot weather concreting, the material shall be pigmented white.

3. Forms shall be loosened as soon as practicable and water curing shall be used as specified.

3.10 RESERVED

3.11 TESTING

A. Concrete materials and operations shall be tested as the work progresses.

B. Duties of testing laboratory shall be as follows:

1. Review, check, and test proposed materials for compliance with Specifications before the start of the work.

2. Sample aggregates from concrete production stockpiles, at least once a month, during the placement of concrete and test for compliance with the specifications. The moisture content of each sample shall be measured and recorded.

3. Review and test proposed mixture design when required by Engineer.

4. Randomly sample concrete during construction in accordance with ASTM C172 and perform scheduled tests.

5. Measure and report surface profile of slabs in accordance with ASTM E1155. Surface profile shall be determined for first trowel finish slab and first float finish slab on project and other slabs specified.

C. Test Schedule:

1. Strength:

a. One strength test shall be made for each 50 cubic yards, or fraction thereof, of each class of concrete placed on any one day. Frequency of testing shall not provide less than 5 strength tests for each class of concrete.

b. Concrete strength test shall consist of three specimens from each sample molded and cured in accordance with the section of ASTM C31, "Curing Specimens for Checking the Adequacy of Mixture Proportions for Strength or as the Basis for Acceptance or Quality Control".

c. Specimens shall be tested in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information. Strength test result shall be average of strengths of 28 day specimens. If one specimen shows evidence of improper molding, handling, or testing, it shall be discarded and remaining specimen shall be considered as strength test result. Should both specimens in a test show any of the above defects, the entire test shall be discarded.

3.12 EVALUATION OF STRENGTH

A. Contractor shall perform concrete mix work and produce concrete structures in full compliance with Specifications.

B. Concrete strength will be considered satisfactory if the average of three consecutive strength test results equals or exceeds the specified strength, and no individual strength test result falls below specified strength by more than 500 psi.

3.13 CONCRETE SCHEDULE

A. Unless indicated otherwise on the Drawings or specified, concrete shall be furnished as follows:

Class A-1: For all structures not defined under Class A-2 or Class B concrete.

Class A-2: For structures that cover, convey or store wastewater such as channels and tanks, and their attached auxiliary structures, and all other concrete that will be submerged or exposed to wastewater.

Class B: Pipe saddle supports, Pipe pier supports, buried electrical duck banks, equipment pads, housekeeping pads and mudmats, unless noted otherwise. The above items shall not be exposed to weather and shall not be submerged in liquids; otherwise they shall be of Class A concrete as specified above.

3.14 CONCRETE FINISHING SCHEDULE

A. Concrete shall be finished as follows unless indicated otherwise:

1. Building Interior:

Floors intended as walking surfaces or to receive a floor covering, bases, and curbs:	Troweled finish.
Other slabs intended to receive roofing, water-proofing membrane or sand bed terrazzo:	Float finish.
Exposed formed surfaces:	Smooth-rubbed finish.
Other formed surfaces:	Rough form finish.

2. Building Exterior:

Slabs, drives, and walks:	Broom finish.
Exposed formed surfaces:	Smooth-rubbed finish to 6-in below grade.
Other formed surfaces:	Rough form finish.

3. Pedestrian Ramps and Exterior Stairs: Non-slip finish.

4. Tanks and Other Liquid Retaining Structures:

Slabs:	Float finish.
Interior formed surfaces:	Grout-cleaned finish.
Exterior formed surfaces:	Grout-cleaned finish to 6-in below grade.
Other formed surfaces:	Rough form finish.

3.15 ELECTRICAL CONDUITS AND LIQUID PIPE EMBEDMENTS

A. Prior to placing concrete with embedded conduits and pipes the contractor shall submit a layout plan drawing that includes the locations, quantity and size of these items. The layout plan shall be submitted to the Engineer at least 14 days prior to placement for approval.

B. Conduits, pipes and sleeves passing through slabs, walls or beams shall not impair significantly the strength of construction. Conduits and pipes shall not be embedded in columns or beams without the approval of the engineer.

C. Conduits and pipes embedded within slabs and walls shall not be larger in outside dimension than one-third the overall thickness of the slab or wall that they are embedded in.

D. Conduits and pipes embedded within slabs and walls shall not be spaced closer than 3 diameters on center.

E. Concrete cover over conduits, pipes and fittings shall not be less than 2 inches.

3.16 HOUSEKEEPING PADS

A. Unreinforced concrete housekeeping pads shall be installed under all floor-mounted items such as motor control centers, electrical panels, control panels, transformers, process equipment, and HVAC equipment unless otherwise specified or detailed on the Drawings. Housekeeping pads shall be Class A concrete 4 inches high with chamfered edges and a troweled finish.

B. Reinforced concrete equipment pads shall be installed under all generators, pumps, motors, blowers, drives or other pieces of equipment that require support greater than 4 inches above the floor. Refer to typical pad details given on the drawings.

PART 4 SPECIAL PROVISIONS

4.01 RESERVED

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing, shop detailing, shop coating, fabricating, delivering, and installing all miscellaneous metals and accessories needed to complete installations as shown on the Drawings, whether or not specifically listed herein, except those items specified in other sections.

1.02 SUBMITTALS

A. Submittals shall be in accordance with requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Shop Drawings shall indicate:

1) Types of materials with ASTM designations.

2) Surface preparation and shop coatings.

3) Accessory materials.

b. Product literature for all materials and accessories required to complete the installation of the items covered in this Section.

c. Samples representative of materials and finished products or requested by the Engineer.

2. Information for the Record:

a. Inspection Reports and test certificates.

b. Required field measurements.

1.03 QUALITY ASSURANCE

A. Standards - Metal fabrications shall be designed, fabricated, and installed in accordance with following standards.

1. "Structural Welding Code D1.1", American Welding Society.

2. "Specifications for Structural Steel Buildings" as approved by American Institute of Steel Construction.

3. "Specifications for the Design of Cold-Formed Steel Structural Members", American Iron and Steel Institute.

4. "Specification for the Design of Cold-Formed Stainless Steel Structural Members", ASCE 8.

5. "Code of Standard Practice for Steel Buildings and Bridges", as approved by American Institute of Steel Construction.

6. "Specification for Aluminum Structures", Aluminum Association.

7. "Specification for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation.

8. "Surface Preparation Specification," Steel Structures Painting Council (SSPC).

1.04 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall exercise particular care in handling materials to prevent damage to shop applied finishes and coatings.

B. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.

C. Fastening materials shall be delivered and stored in unopened boxes with labels clearly identifying fastener material, grade, and manufacturer. Only those fasteners which can be installed in same day shall be removed from storage.

1.05 PROJECT CONDITIONS

A. Prior to fabrication, Contractor shall field measure new and existing structures when required for proper fit.

PART 2 PRODUCTS

2.01 RESERVED

2.02 RESERVED

2.03 ANCHOR BOLTS

A. General Requirements:

1. Bolt and Stud Material:

Carbon Steel - ASTM F1554 Grade 36, unless noted otherwise.

Stainless Steel - ASTM F593, AISI Type 304.

2. Heavy hex nuts and washers of same material and coating as anchor shall be furnished. Where lock nut is indicated, prevailing torque type lock nut shall be furnished in addition to standard nut.

3. Anchor Bolt Sleeves:

Steel Pipe - ASTM A501, ASTM A120, or ASTM A53.

Plastic - Wilson "Ankor Shield" or equal.

B. Adhesive Anchor (Type B):

1. Adhesive - 100 percent solids, 100 percent reactive epoxy (ester-based resins are not permitted) in conformance with ASTM C881, Type IV, Grade 3, Class B and C. Minimum bond strength to concrete, per ASTM C882, shall be 1800 psi at 7 days. Adhesive shall be mixed in accordance with manufacturer's recommendations. The adhesive shall be formulated to withstand the maximum allowable published load permanently without creep or failure.

2. Where adhesive anchor is installed in hollow masonry, stainless steel screen tubes shall be furnished to contain adhesive until stud is inserted.

3. The anchor rods shall be threaded for entire length. Carbon steel rods shall conform to ASTM A193 B7 (high strength) and stainless steel rods shall conform to AISI 304.

4. Stud shall be threaded full length.

5. Adhesive anchors shall be type "HIT-RE-500-V3" manufactured by Hilti, or equal. All formulations of the "Power-Fast Epoxy" as manufactured by Powers/Rawl shall not be used.

C. Expansion Anchor (Type C):

1. Wedge Type Anchors - Federal Specification A-A 1923A, Type 4.

2. All components shall be of same material.

3. Expansion anchors shall be type "Kwik Bolt 3" manufactured by Hilti, or equal.

2.04 RESERVED

2.05 GASKETS

A. Where gaskets are required for the assembly or installation of metal fabrications, oil and gas resistant neoprene shall be furnished. Hardness of gasket shall be as appropriate for specific application.

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 RESERVED

2.10 RESERVED

2.11 RESERVED

2.12 RESERVED

2.13 RESERVED

2.14 RESERVED

2.15 RESERVED

2.16 RESERVED

2.17 RESERVED

2.18 RESERVED

2.19 RESERVED

PART 3 EXECUTION

3.01 RESERVED

3.02 RESERVED

3.03 ANCHOR BOLT INSTALLATION

A. Non cast-in type anchors shall be installed in predrilled holes of size specified or as recommended by manufacturer. Anchors shall be embedded to depth indicated below unless shown otherwise on the Drawings.

B. Anchor bolted connections shall be Snug-Tightened- in accordance with "Specification for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation or as otherwise specified by anchor manufacturer.

C. Expansion Anchor:

1. Unless indicated otherwise, expansion anchors shall be embedded as follows:

Stud Diameter	Minimum Embedment
1/4 inch	2 inches
3/8 inch	2-1/2 inches
1/2 inch	3-1/2 inches
5/8 inch	4 inches
3/4 inch	4-3/4 inches
1 inch	6 inches

2. Unless indicated otherwise, expansion anchors shall be spaced as follows:

Minimum center to center spacing: 2 times embedment.

Minimum edge distance: 3 times embedment.

3. Unsound concrete shall be reported to Engineer.

D. Adhesive Anchor:

1. Adhesive anchors shall be placed in holes larger than stud diameter using a rotary percussion hammer and carbide bit. Hole diameters shall be as recommended by manufacturer for each specific anchor diameter.

2. Unless indicated otherwise, Adhesive anchors shall be embedded as follows:

Stud Diameter	Minimum Embedment
3/8 inch	3-3/8 inches
1/2 inch	4-1/2 inches
5/8 inch	5 5/8 inches
3/4 inch	6-3/4 inches
7/8 inch	7-7/8 inches
1 inch	9 inches

3. Preparation Procedure:

a. Hole shall be cleaned of dust and residue by blasting with dry and oil-free compressed air. Air nozzle shall be inserted to bottom of hole.

b. Sides of hole shall be cleaned with a nylon bristle brush.

c. Compressed air blast shall be repeated.

4. Standing water and frost shall be removed immediately prior to injecting adhesive.

5. Adhesive shall be injected from bulk-loading caulking gun, disposable caulking tubes, or pneumatic dispenser. Adhesive shall be injected using extension on nozzle to reach bottom of drilled hole.

   Anchoring to Concrete - Nozzle shall be inserted to back of hole and adhesive dispensed while slowly withdrawing nozzle. Hole shall be filled to pre-determined depth which will cause hole to be completely filled after stud is inserted.

   Anchoring to Masonry - Screen tube shall be filled with adhesive while slowly withdrawing nozzle. Screen tube shall be carefully inserted into drilled hole.

6. Stud shall be pushed into adhesive with gentle, uniform pressure while slightly rotated to ensure adhesive completely surrounds stud. Stud shall be inserted to full depth of hole.

7. Adhesive displaced from hole shall be removed immediately. Adhesive which has hardened on projecting portion of stud or on concrete surfaces shall be removed.

8. Nut shall not be tightened nor load applied until adhesive has fully cured as recommended by manufacturer.

3.04 FASTENER AND ANCHOR SCHEDULE

A. Unless shown or specified otherwise, fasteners and anchors shall be as follows:

Base Metal	Fastener Metal and Coating
Stainless steel	Stainless Steel
Aluminum	Stainless Steel
Galvanized steel	Galvanized or zinc plated carbon steel
Field painted or uncoated carbon steel	Unfinished or zinc plated carbon steel

B. Where a connection involves dissimilar base metals, fastener shall be as required for most corrosion resistant base metal in connection, or dielectric material shall be installed.

C. Anchors bolts and fasteners in submerged applications shall be stainless steel.

D. Where anchor type is not shown or specified, anchor furnished shall be suitable for substrate material and specific application. Adhesive anchors are not permitted for anchoring to vertical or overhead surfaces inside of buildings or other fire rated locations.

Substrate Material	Suitable Anchor Type
Concrete	A, B, C
Solid or Grouted Masonry	A, B, D
Hollow Masonry	B, D

3.05 RESERVED

3.06 RESERVED

3.07 RESERVED

3.08 RESERVED

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 11050

COMMON EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. The Section includes the general requirements for all equipment installed under this Contract.

B. Equipment items shall meet the requirements specified herein, plus the specific requirements noted in the technical sections.

C. The specific requirements included under a particular section shall take precedence.

D. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Specific equipment submittals are specified in the related sections.

b. Equipment Shop Drawings shall include outline and dimension drawings of the actual equipment being furnished.

c. With the shop drawings, the complete motor nameplate data shall be furnished as well as all information requested below which may not be on the motor nameplate:

1) Manufacturer.

2) Rated Horsepower.

3) Operating Speed Range*

4) Operating Voltage(s).

5) Current Draws at Operating Voltage(s)*

6) Operating Frequency (Hz).

7) Service Factor.

8) Type Enclosure.

9) Frame Size.

10) NEMA Design Designation.

11) Locked Rotor Code Letter.

12) Duty Rating.

13) Minimum Full Load Efficiency.

14) Nominal Efficiency*

15) Power Factor*

16) Maximum Size Capacitor Permitted To Be Connected to Motor.

17) Insulation Class.

18) Location of motor terminal housing (F1 or F2).

19) Motor no load sound pressure level of dB(A) weighted at 3 feet from motor.

20) Motor Full Load Sound Pressure Level of dB(A) - weighted at 3 feet from motor.

21) Bearing Ratings.

22) Full Load Torque.

23) Break Down Torque.

24) Locked Rotor Torque.

* Provide data at following loads: Service factor (if greater than 1.0) times full load (i.e., 1.15 x full load), 100 percent, 75 percent, 50 percent, 25 percent, and no load.

d. Minimum full load efficiency shall be tested in accordance with IEEE Standards 112 Test Method B as described in Section 6.4 of IEEE Standard 112. Polyphase motors larger than 125 horsepower shall be listed in accordance with IEEE Standard 112 with stray-load loss determined by direct or indirect measurements.

2. Information for the Record:

a. Operation and Maintenance Manual information.

1.03 QUALITY ASSURANCE

A. Manufacturer's name, make, model number and other designations provided in the contract documents are to establish the significant characteristics, including but not limited to, type, function, dimensions and physical properties, performance, and appearance for the purpose of evaluating comparable products. Contractor shall verify product, equipment or system proposed meets or exceeds the requirements as specified or shown on the drawings.

1.04 ELECTRICAL AND CONTROL COORDINATION

A. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit, and/or starter for that motor or equipment must be increased from that shown on the Electrical Drawings, the Contractor shall furnish and install the larger items. The increased wiring, conduit, and/or starter cost shall be included under the Contract and no additional compensation will be allowed.

B. All electrical, instrumentation, and control equipment and panels furnished under this Contract shall conform to appropriate Sections of Division 16 of these Specifications. Equipment and panels shall be NEMA 4X, unless otherwise shown on the Drawings or Specifications.

C. Certain equipment items shall be connected to the plant control system as shown on the Control Drawings. Those connections and any remote control connections shall be wired to clearly labeled terminal strips within the equipment control panel.

D. Analog signals for input to a programmable controller system or other device shall be 4-20 mADC and where required, current to current transducers or other device shall be furnished to produce an isolated signal to the programmable controller analog input module.

E. Digital input signal sources shall provide an isolated contact rated at 5 AMP minimum, 115 VAC for AC programmable controller inputs or devices and 1 AMP minimum 28 VDC for DC rated inputs or devices.

1.05 PRODUCT HANDLING

A. Unless otherwise specified in the individual Sections, the Contractor shall deliver, handle, store, and maintain materials and equipment in accordance with the requirements of the manufacturer.

B. Materials, equipment, and articles to be incorporated into the Work shall be stored so as to facilitate inspection and inventory and in such manner as to ensure the preservation of their quality and fitness for the Work. Stocked materials shall be subject to test and shall meet the requirements of the Specifications at the time of substantial completion of the Work.

C. The Contractor shall confine his equipment, the storage of materials and equipment, and the operations of his workers to areas permitted by law, ordinances, permits, and the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

D. Switchgear, motor control centers, panelboards, instrument control panels, fixtures, and like equipment shall be received and stored in a dry, clean, dust-free, heated area. If no such area is available at the time such equipment is received, such space shall be provided by the Contractor at no expense to the Owner. If equipment is stored in an area conducive to the formation of condensation, heaters shall be provided to prevent condensation. Once the equipment is installed in its final position, suitable protection shall be provided to prevent damage by falling material, dust, paint, dirt, and moisture.

PART 2 PRODUCTS

2.01 GENERAL

A. AC motor(s) shall conform to the latest applicable NEMA, IEEE, and ANSI standards.

B. Motor installation shall not exceed 88 dB (A) weighted maximum level at 3 feet from the motor throughout the entire speed range and load range.

C. Motor bearings shall be antifriction type, grease lubricated with a minimum L-10 rating of 17,500 hours for belted duty and 100,000 hours for direct coupled duty.

1. Thrust bearings in vertical motors shall be adequate for the loading encountered.

2. Belt-driven power systems with jackshafts, and couplings, to isolate the belt loadings from the motor bearings shall be regarded as direct coupled duty.

D. Motor conduit boxes shall be sized with capacity to meet the requirements of the National Electrical Code. Motors shall be furnished in an "F1" terminal housing assembly (facing connection box, motor shaft extension is to the right) unless otherwise shown on Drawings or specified.

E. Motor frames shall be cast iron construction with corrosion resistant hardware.

F. Each motor shall be continuous duty rated NEMA Design B with normal starting torque, unless otherwise shown or specified.

G. Output torque and speed characteristics of each motor shall be suitable to operate the connected load over the full range of operating speeds and load conditions without exceeding the nameplate current rating or temperature rise on a continuous duty basis.

H. Insulation shall be class F or class H.

I. Each polyphase squirrel-cage induction motor shall meet or exceed minimum and nominal efficiencies listed in NEMA MG-1, Table 12-10.

2.02 RESERVED

2.03 INTEGRAL AC MOTORS

A. AC motor(s) 1 hp and larger shall have a 1.15 service factor at a 40 degrees C ambient temperature. Motor shall be capable of operating at the 1.15 service factor rating on a continuous basis per NEMA MG1-12.42 Item 1b.

B. Motor enclosure types shall be as specified in the equipment specifications and shall be of one of the following designations.

1. Open drip-proof protected (ODP).

2. Totally enclosed non-ventilated (TENV), or totally enclosed fan cooled (TEFC).

3. Explosion proof Class 1, Division 1, Group D.

4. Submersible water cooled.

C. Multi-speed motors shall have the energy efficient design designated for the high speed winding operation.

2.04 RESERVED

2.05 RESERVED

2.06 MOTORS ON VARIABLE FREQUENCY DRIVES

A. Motors for use with a Variable Frequency Drive (VFD) shall be TENV, TEFC, or submersible, water cooled.

1. Design to meet or exceed the efficiencies listed in NEMA MG-1, Table 12-10.

2. Motor shall be "Inverter Duty Rated", and so stamped on the nameplate.

3. Motor shall have an insulation system that meets or exceeds the requirements of NEMA MG-1, Part 31.40.4.2, and is rated at 1600 volts peak to ensure that the motor is rated for operation with non-sinusoidal waveforms at 1.0 service factor.

4. Bearings in motors greater than NEMA Frame size of 300 and controlled by variable frequency drives must be guaranteed against premature bearing failure caused by discharge current. All such motors shall be provided with a shaft grounding device.

B. AC motor used with a VFD shall have internal thermal protectors guaranteed by the motor manufacturer to protect the motors against overheating from stalled or slow turning due to lack of adequate cooling at low motor speeds.

1. Thermal protection devices shall be imbedded within the motor windings with normally closed contacts to be used in series with the coil of the motor's magnetic bypass starter and the stop circuit on the VFD.

2. Thermal protection devices shall all be provided and housed within the motor housing, unless otherwise specified.

C. Explosion proof motors shall use thermal protectors required by UL as covered by 2.08, and meet the requirements of 2.06 preceding, and shall be rated and labeled for "Inverter Duty".

D. Tachometer generators when required by the Specifications or the P&ID Drawings shall be D.C. Generators of the enclosure required for the particular motor location.

2.07 RESERVED

2.08 RESERVED

2.09 RESERVED

2.10 RESERVED

2.11 COUPLED DRIVES

A. Coupled drives shall have the service factor recommended by the coupling manufacturer.

B. Coupled drives shall be submitted with Engineering Data supporting the horsepower rating of each coupling.

2.12 SAFETY GUARDS

A. Installed equipment shall be equipped with all guards, shields, and devices to meet OSHA requirements.

B. Chain and belt guards shall be totally enclosed steel construction, 14 gauge minimum for guards up to 60-inch center distance and 12 gauge minimum for larger guards.

C. Guards shall include expanded metal inspection panels. Removable access panels shall be provided to perform routine maintenance.

2.13 MANUFACTURER'S NAMEPLATE

A. Equipment shall be identified by permanently attached nameplate of corrosion-resistant metal. Plates shall bear the following information:

1. Manufacturer's name.
2. Serial and model numbers.
3. Rated capacity.
4. Temperature, pressure, or other limitations.

2.14 ANCHOR BOLTS

A. Equipment anchor bolts shall be as specified in Section 05500.

PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer's instructions and Contract Documents. Required anchors, grout, and leveling shims shall be provided by the Contractor.

B. Alignment procedures and acceptable runout tolerances on couplings shall be submitted.

3.02 ROTATING EQUIPMENT ALIGNMENT

A. To aid in the field alignment of all equipment base plate mounted rotating equipment, push bolts (jacking bolts) shall be furnished and welded to the base plate.

B. All rotating equipment shall be field checked for alignment after installation and initial operation. The equipment shall be at operating temperature. The minimum method of indicating alignment will be the "16-point" method. Other proposed methods must be submitted for approval to the Engineer.

C. The alignment results are to be submitted for record. They are to include the final set of indicator readings and a plan view sketch of the motor and driven machine base, and the thickness of shims for each shimmed anchor bolt. The thickness of shims shall not exceed 0.25 inches.

3.03 INITIAL LUBRICATION

A. Initial lubrication required for start-up, field test operation, and normal operation prior to substantial completion shall be furnished and applied in accordance with the manufacturer's recommendations.

B. Where lubricating points are not easily accessible, provide extensions as required for easy access with normal grease gun.

3.04 PACKING

A. Each shaft containing a packing gland shall be checked for condition by backing the packing gland off and examining for proper grade, amount, and type of packing as recommended by the manufacturer.

3.05 MAINTENANCE

A. The Contractor shall perform and log all preventive maintenance tasks as recommended by the manufacturer while the equipment is in storage and after installation until the equipment has been accepted by the Owner.

3.06 TROUBLESHOOTING

A. Should a problem occur before acceptance, the Contractor shall determine the cause and recommend corrective actions to the Engineer. The Contractor shall correct equipment and installation deficiencies.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 11735

PUMPING EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing and installing of pumping equipment as shown on the Drawings, as scheduled in Part 4, and as specified herein.

B. The pumping equipment shall be furnished with all drives, drive shafts, couplings, steady bearings, belts, drive shaft and belt guards, drive bases, pump bases, anchor bolts, anchor bolt sleeves, and other appurtenances as specified or required for a complete installation and satisfactory operation.

C. All work performed under this Section shall be in accordance with all approved trade practices and manufacturers' recommendations.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Warranty Submittals - At the time of shop drawing submittal, the Contractor shall submit a written warranty from the manufacturer(s) covering workmanship and materials on those pumps with drive motors of 7-1/2 hp or larger when used as intended for this installation. Warranty period shall be one-year, unless specified otherwise. The warranty period shall commence on the date of Substantial Completion. Under terms of this warranty, the manufacturer shall furnish and install all replacement parts for any defective component at no cost to the Owner. The provisions of this warranty shall not be construed as relieving or reducing the obligations of the Contractor outlined in the General Conditions of these Specifications.

2. Submittals for Record - For pumps with drive motors of 7-1/2 hp or larger, the Contractor shall submit an installation and operation certificate and a statement from the manufacturer that the equipment is suitable for the intended use.

3. Submittals for Review:

a. Shop Drawings.

b. Manufacturer's Literature.

c. Manufacturer's Certificates, including certified test curves (computer model printouts are not acceptable).

d. Motor data in accordance with Section 11050.

4. Submittals for Operation and Maintenance.

PART 2 PRODUCTS

2.01 PUMPS

A. General:

1. Each pump shall be designed and furnished to meet the operating conditions specified in Part 4 of this Section. The type of pump for each service is given in the Schedule in Part 4.

2. Each pump shall be of the manufacturer and model listed in Part 4 or equal. All pumps used for one type of service shall be of the same manufacturer.

3. Each pump shall be shop tested in accordance with standards of the Hydraulic Institute. Six copies of certified test curves indicating capacity, head, efficiency, brake horsepower, and speed shall be submitted to the Engineer for approval. No pump shall be shipped to the job site until the test curves have been approved by the Engineer.

4. No point on the centrifugal pump performance curve shall require more than the nameplate horsepower of the drive motor.

B. Vertical Turbine Pumps:

1. Vertical turbine pumps shall be in accordance with the requirements described in the following paragraphs and in Part 4 of this Section.

   a. The bowl assembly shall consist of a suction bell with one or more intermediate and discharge bowls. Interior of bowls shall be lined with fused glass enamel or similar material. Exterior of bowls, and interior and exterior of suction bell shall be coated with Tnemec Potopox 141 or similar material approved for potable water service.

   b. The bearing housing and bowl shall be of one-piece construction and made of cast iron accurately machined and fitted for positive alignment.

   c. The impeller shall be of a high efficiency design and made of aluminum bronze ASTM B148 Alloy C95200 unless otherwise specified in Part 4 and precision machined, finished, and balanced.

   d. The pump bowls shall utilize wear rings that are press-fit or with an end seal design such that the lateral impeller setting is used to adjust the wear clearance between the end of the impeller hub and a replaceable steel core neoprene lateral seal ring in the bottom of the bowl allowing future readjustment of the wearing clearances by readjusting the lateral setting on the pump. The impeller shall have "Integral wear ring" design with a hub design of sufficient thickness to allow for future installation of a wear ring.

2. The discharge column shall be flanged steel and provided in 5-feet maximum sections for ease of assembly and disassembly. Column flange bolts shall be stainless steel. Lineshaft shall be 416 stainless steel, supported by bronze bearings, and bearing retainers located every 5 feet for a close tolerance positive alignment. The lineshaft bearings shall be lubricated by the water being pumped. The lineshaft coupling shall be 410 stainless steel, 416 stainless steel couplings will not be acceptable. The threaded lineshaft coupling shall have a "weep hole" to expel excess anti-seize compound and allow the shaft faces to firmly butt together.

3. The discharge head shall be fabricated steel or single cast iron design equipped with an ANSI discharge flange. The discharge head shall be designed to withstand all stresses incidental to service, including a vertical hollow shaft mounting assembly and driver. Large hand holes in the mounting assembly shall be provided

for ease of adjusting the packing. A tap and plumbing for draining the stuffing box leakage shall also be provided.

4. At the top of the discharge head, a heavy duty stuffing box with rotating Flex-A-Seal or ISC2 mechanical seal shall be provided. Seal faces shall be carbon/tungsten carbide. A bronze bearing at the base of the discharge head shall be provided.

5. The pumps shall have NPSH requirements low enough to permit a smooth and vibration-free operation when pumping water at temperatures between 35 and 70 degrees F under the operating conditions listed in Part 4.

6. Each pump shall be equipped with an anti-vortex suppressor attached to the suction bell. Anti-vortex suppressor shall be type 316 stainless steel.

7. Where shown on the Drawing and required in Part 4, the pump supplier shall provide "cans" around the pump bowls and discharge column to the underside of the pump head. Cans shall be designed by the pump supplier and condition the horizontal inlet flow to provide the manufacturer's recommended flow regime around the pump bowl inlet. The can's inlet flange shall provide an inlet velocity of not greater than 4 feet per second at the pumps maximum operating point provided in Part 4. Cans shall be carbon steel and painted with NFS approved paint. Pump base shall include 1 inch NPT tap for air vent from interior of can.

2.02 RESERVED

2.03 VARIABLE SPEED DRIVES AND CONTROLS

A. See Specification Section 16230.

2.04 MOTORS

A. Motors shall conform to the requirements of Section 11050.

2.05 ACCESSORIES

A. Each pump shall be provided with easily identifiable terminal points to facilitate the exchange of the central control functions between the pumps and the process control system as indicated on the Contract Drawings.

B. Pressure Gauges and Connections:

1. Pump suction and discharge flanges shall be tapped for gauge connections as indicated in the Specifications.

2. Gauge connections shall be 1/4-inch in diameter.

3. Each connection shall include a shutoff needle valve and necessary lengths of pipe to allow the mounting of a pressure gauge. The open end on the gauge connection shall be plugged to prevent the accumulation of debris.

4. Each pump or set of pumps used for one application shall be supplied with two pressure gauges. One gauge shall be adequately sized to indicate discharge pressure while the other shall be adequately sized to indicate the suction conditions. The gauges shall be properly installed on the pump suction and discharge lines. Gauges shall be a product of H. O. Trerice, Ashcroft, or equal as specified in Section 15400.

5. Submersible pumps shall be supplied with a discharge gauge only. Gauge shall be located in the discharge piping at a location easy to access.

C. Each set of pumps shall be provided with one set of special tools required for complete service and maintenance.

2.06 RESERVED

2.07 SHOP PAINTING

A. Shop painting shall be in accordance with the requirements of Section 01350.

PART 3 EXECUTION

3.01 ERECTION

A. The equipment shall be erected in accordance with the manufacturer's recommendations. Required grout and leveling shims shall be provided by the Contractor.

3.02 INITIAL LUBRICATION

A. Initial lubrication required for start-up and field test operation shall be furnished and applied in accordance with the manufacturer's recommendations.

3.03 INSPECTION, START-UP, AND TESTING

A. The Contractor shall furnish a qualified representative of the manufacturer to perform inspection, start-up, and training services. The manufacturer's representative shall be experienced in the installation, start-up, operation, and maintenance of the equipment.

B. The representative shall check the installation and supervise final adjustments and initial start-up of the equipment. He shall certify that the installation is correct and that the equipment is operating satisfactorily. This service shall be for a minimum period of one trip and one day.

C. Within two weeks of start-up, the manufacturer shall submit to the Engineer a written report (minimum 4 copies) covering the representative's inspection and start-up of the equipment. This report shall include the manufacturer's certification that the installation is correct and that the equipment is operating satisfactorily.

D. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel for one, eight-hour day in the proper operation and maintenance of the equipment. The Owner may videotape the training.

E. In addition to the initial training, the manufacturer shall provide one, eight-hour day of training at the time requested by the Owner within the one-year maintenance and guarantee period. This service would be in addition to any warranty work.

PART 4 SPECIAL PROVISIONS

4.01 PUMP SCHEDULE

Service	Quantity	Type	Location
High Service Pump 6	1	Vertical Turbine	Pump Room

A. Certified shop test pump curves are required for High Service and Transfer pumps. For the remaining pumps: in lieu of the pump shop test specified in paragraph 2.01, A, 3. the Contractor may submit catalog performance curves for the pumps to be furnished provided they are certified by the pump manufacturer to be an accurate representation of the pumps performance.

A. Transfer pump motor speed shall be controlled by a variable frequency drive, See Specification Section 16230.

4.02 HIGH SERVICE PUMP (HSP6)

A. One complete pumping unit is required.

B. Operating Conditions/Requirements:

Intended Use:	Pump Finished Water to Distribution System
Operation :	Intermittent/Continuous
Solution:	Potable water
Solution Temperature:	32 – 80 degrees F
Suction:	Flooded 15 feet max. head
Discharge:	Above grade
Seal Water:	From casing
Base Plate/Sub-Base Plate:	By Pump Supplier

C. High Service Pump 6:

Number:	One
Design Capacity and Head:	6,000 gpm at 200 feet TDH
Minimum Bowl Efficiency @ Design Pt:	40% 50%
Motor:	450 HP minimum, 1,200 rpm, 480 volt, 3 phase, 60 Hertz, Premium Efficiency, Inverter Duty
Minimum Stages:	3
Discharge Size:	16-inch
Discharge Centerline Elevation:	843.25±
Pump Model:	Floway 20MKH

D. High service pump motor speed shall be controlled by a variable frequency drive, see Specification Section 16230.

END OF SECTION

SECTION 15010

GENERAL MECHANICAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing mechanical accessories and requirements necessary for the completion of the Work whether or not specifically shown or specified.

B. Items include, but are not limited to:

1. Piping Hangers and Supports.
2. Insulation Fire Retardant Requirement.
3. Accessibility and Access Panels.
4. Power Actuated Anchors.
5. Rotating Equipment Alignment.

C. Additional requirements are specified in Sections 01350 and 11050.

1.02 SUBMITTALS

A. Submittals shall be in accordance with requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
   a. Descriptive information on all mechanical items.
   b. Drawings locating anchors, inserts, and supports for piping, including vendor data for each component.
2. Information for the Record:
   a. Alignment procedures and acceptable runout tolerances for each piece of connected equipment.
   b. Shaft and bore sizes and tolerances for couplings and instructions for coupling installation.
   c. A report of coupling alignment readings for each coupling and driven machine combination, and sizes of all anchor bolt or equipment base shims.

PART 2 PRODUCTS

2.01 PIPING HANGERS AND SUPPORTS

A. The manufacturer's names and catalog numbers shown in the following paragraphs have been used as a guide to type, style, and materials of construction only. Anvill, Unistrut, or equal.

B. Contractor shall furnish and install all pipe supports, hangers, harnessing, expansion joints, expansion loops, and inserts required to support the piping and valves. Supports shall be designed and spaced to secure pipe in place without sag or undue stress on any pipe, fitting, equipment, or valve. Piping that is close to the floor may be supported on concrete piers.

Piping near walls may be supported by wall brackets. Piping at equipment and valves, etc., shall be supported so that the equipment and valves can be removed without additional pipe supports. Piping shall not introduce any strains or distortion to connected equipment. Overhead lines shall be installed directly on supports, or suspended by hangers or hanger rods. Where piping is supported from the ceiling, inserts shall be poured in the concrete slab flush with the bottom of the slab. Adequate lateral support shall be provided to prevent noticeable lateral movement of the piping either during operation, or from a lateral load of 300 pounds applied at any point. All hanger design, anchoring, support, etc. shall be the responsibility of the Contractor. Design loads shall not exceed the manufacturer's recommended loads.

C. Types of Supports:

1. All horizontal piping 4-inch and larger with inverts 2-feet or less from a finished floor shall be supported by Steel saddle supports, unless otherwise specified in Part 4 of this Section.

2.02 RESERVED

PART 3 EXECUTION

3.01 RESERVED

3.02 RESERVED

3.03 ROTATING EQUIPMENT ALIGNMENT

A. To aid in the field alignment of all equipment base plate mounted rotating equipment, push bolts (jacking bolts) shall be furnished and welded to the base plate.

B. All rotating equipment shall be field checked for alignment after installation and initial operation. The equipment shall be at operating temperature. The minimum method of indicating alignment will be the "16-point" method. Other proposed methods must be submitted for approval to the Engineer.

C. The alignment results are to be submitted for record. They are to include the final set of indicator readings and a plan view sketch of the motor and driven machine base, and the thickness of shims for each shimmed anchor bolt. The thickness of shims shall not exceed 0.25 inches.

PART 4 SPECIAL PROVISIONS

4.01 SUPPORT MATERIAL SCHEDULE

A. All exterior supports shall be 304 Stainless Steel.

END OF SECTION

SECTION 15210

PIPING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing and installing of all pipelines 4-inch diameter and larger shown on the Drawings or as required to complete the Work.

B. Piping less than 4-inch diameter, will be included under other Sections unless otherwise specified.

C. Material to be furnished and installed, but not limited to:

1. All pipe, fittings, specials, bends, beveled pipe, adapters, bulkheads, stoppers, plugs, joint restraints, joints and jointing materials.

2. Pipe supports other than those specified in Section 15010.

3. Make connections to all existing and/or new facilities and provide temporary services.

4. Install temporary plugs and/or stoppers and harnessing.

5. Test and clean pipelines.

6. Sterilize water mains.

D. The Contractor shall make adequate field measurements before new piping is fabricated.

E. All wall, floor, and roof penetrations and any building modifications which are required for the installation of the work under this Section shall be included in this Section.

F. Instruments which are to be located in pipelines 4-inch in diameter and larger shall be furnished under Division 16 and installed under this Section.

1.02 QUALITY CONTROL

A. Laboratory Services - Laboratory testing services shall be provided as specified under Section 01410 of the Specifications.

B. Field Inspection:

1. All pipe sections, specials, and jointing materials shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered installed shall be removed and replaced with a sound one in a manner satisfactory to the Resident Project Representative at the Contractor's expense.

2. Defective material shall be marked with lumber crayon and removed from the job site before the end of the following day.

C. Field Testing:

1. All materials, process of manufacturing, and finished pipe shall be subject to inspection and approval.

2. The Resident Project Representative may select one sample of pipe on the job site of each production run of each size and type of pipe to be tested by the laboratory. The Contractor shall furnish the first test piece or pipe core and any additional

samples required because of failures. Should the sample fail to meet specifications, retests shall be conducted by the laboratory in conformance with the specifications.

D. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300 showing: layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, and any special provisions required for assembly.

B. Shop drawings shall be drawn to not less than 1/4-inch scale and show the laying length and piece mark for each section of pipe and fitting.

C. Drawings shall show the position and elevation of valves, pumps, and/or other equipment served by the various pipe systems.

D. If directed by the Engineer, each certificate shall be accompanied by a report showing test results compared to specification requirements. Test specimens shall be selected in conformance with the designated specification, except that no less than two tests shall be made for each production run of each size, type, and class of pipe furnished, and further, that in case tests are unsatisfactory, additional tests shall be made to the maximum number in the referenced ASTM Specification.

E. Submit a schedule of all proposed pipe escutcheons.

F. Other submittals may appear in Part 4 of this Section.

PART 2 PRODUCTS

2.01 RESERVED

2.02 RESERVED

2.03 PROCESS AND PRESSURE PIPE

A. Ductile Iron Pressure Pipe (DIP):

1. Ductile Iron Pressure Pipe (DIP) shall conform to ANSI A-21.51 or AWWA C-151 and shall be pressure class 350 psi for sizes 12-inch and below, and pressure class 300 psi for larger sizes unless otherwise specified herein. Mechanical joint fittings shall be ductile iron and conform to ANSI A-21.10 or AWWA C110 and ANSI A-21.53 or AWWA C-153. Flanged fittings shall be ductile iron and conform to ANSI A-21.15 or AWWA C115. All fittings shall have a pressure rating of 250 psi for all pipe sizes unless otherwise specified.

2. Ductile Iron pipe inside buildings or structures shall be joined with flanged joints as shown on the Drawings, or as indicated in the pipe schedule. Flanges shall comply with ANSI 21.15 or AWWA C-115 and shall be ANSI 125 pound drilling, unless otherwise specified. Flanged joints shall have full face 1/8-inch rubber gaskets or of thickness and type approved by the Engineer. The pipe shall not be threaded or flanged in the field. Flanges shall be firmly bolted with machine, stud, or tap bolts of the proper size and number. Within buildings the bolts and nuts shall be of the best quality mild steel, with true threads, meeting the requirements of ANSI B16.1.

2.04 PROCESS AND PRESSURE PIPE NUTS AND BOLTS

A. Nuts and bolts used on buried pressure pipe and fittings in contact with earth shall be Cor-Blue coated low alloy steel and have a minimum yield strength of 45,000 psi complying with ANSI A21.11 and AWWAC-111.

B. Nuts and bolts encased in grout on concrete pressure pipe shall conform to recommendations of the pipe manufacturer.

C. All other nuts and bolts shall be low carbon steel in conformance with the chemical and mechanical requirements of ASTM A-307, Grade B. Higher strength bolts will be acceptable.

D. All piping, vales, and pumps shall be field painted with NSF61 certified epoxy primer and paint of a color as chosen by the Owner.

2.05 PIPE HANGERS AND SUPPORTS

A. Pipe hangers and supports shall be as specified in Section 15010.

2.06 COATINGS AND LININGS OF PROCESS AND PRESSURE PIPE

A. Coatings and linings where required shall conform to the following requirements unless otherwise indicated in Part 4 of this Section or on the Drawings.

B. Ductile Iron Pipe:

1. Ductile iron pipe, and fittings unless otherwise specified, shall be lined on the interior with a standard thickness cement lining meeting ANSI Specification A-21.4 and AWWA C-104. A seal coat of bituminous material shall be applied in conformance with the above Specifications. Piping used for compressed air shall not receive a cement lining.

2. All pipe used within buildings and structures and which are to receive field coats of paint shall not be coated with any black bituminous paint. Such pipe, after proper cleaning, shall be painted with one coat of primer paint that is compatible with the field coats. Painting specifications shall be followed for cleaning and painting.

2.07 RESERVED

2.08 RESERVED

2.09 RESERVED

2.10 RESERVED

PART 3 EXECUTION

3.01 PRODUCT HANDLING

A. Care shall be taken in handling and transporting to avoid damaging pipes and their coatings. Loading and unloading shall be accomplished with the pipe under control at all times and under no circumstances shall the pipe be dropped. Pipe shall be securely wedged and restrained during transportation and supported on blocks when stored in the shop or field.

B. Store all pipe on a flat surface so as to support the barrel evenly. It is not recommended that pipe be stacked higher than 4-feet. Plastic pipe, if stored outside, shall be covered with an opaque material to protect it from the sun's rays.

3.02 RESERVED

3.03 PIPE INSTALLATION

A. General:

1. All pipe shall be laid to lines and grades in conformance with Section 01800.

2. Pipe Anchoring:

a. Disjointing hydrostatic pressure at bends, valves, plugs, tees, and wyes shall be counteracted by restrained joints or reinforced concrete anchorage as directed on the Drawings or specified.

b. Thrust blocks shall be installed only where directed or specifically called for on the Drawings, unless otherwise specified. Installation shall be in conformance with Drawings.

c. Approved joint restraints shall be installed for the distance from each side of each bend, valve, plug, tee, or wye in locations shown or scheduled on the Drawings.

d. Reinforced concrete joint anchorage shall be installed in conformance with the Drawings.

B. Process and Pressure Pipe:

1. Pipe and appurtenances shall be installed true to line, grade, and location; with joints centered, spigots home; pipe properly supported and restrained against movement; and all valve stems plumb.

2. All elbows, tees, plugs, etc., shall be properly anchored, blocked, or otherwise restrained to prevent movement of the pipe in the joints due to internal or external pressure.

3. The open ends of all pipes and special castings shall be plugged or otherwise closed with a watertight plug to the approval of the Resident Project Representative before leaving the work for the night, and at other times of interruption of the work. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.

4. Where new or existing pipe requires cutting in the field it shall be done in a manner to leave a smooth end at right angles to the pipe centerline. The finished cut must be approved by the Resident Project Representative.

5. Joints:

a. Gaskets - Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the pipe manufacturer. If the gasket is found not to be in proper position, the pipes shall be separated and the damaged gasket replaced. The pipe is then forced "home" firmly and fully. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.

b. Where new piping is to be connected into an existing joint, said joint shall be cleaned sufficiently to result in a liquid- or gastight seal. If applicable, a new gasket shall be supplied and installed.

3.04 RESERVED

3.05 RESERVED

3.06 RESERVED

3.07 RESERVED

3.08 PRESSURE AND LEAKAGE TESTS FOR PROCESS AND PRESSURE PIPE

A. The Contractor shall furnish the pump, pipe connections, taps, gauges, auxiliary water container, bulkheads, plugs, and other necessary equipment and make pressure and leakage tests of all lines including the joint between existing and new pipes unless otherwise directed by the Engineer.

B. Tests shall be conducted on all pipelines or valved sections thereof as directed by the Resident Project Representative. Testing of pipelines laid in excavation or bedded in concrete shall be done prior to backfilling or placing concrete cover, except restrained sections of pipe which shall be backfilling prior to testing, unless otherwise permitted by the Engineer. Tests on lines anchored or blocked by concrete shall not be conducted until the concrete has taken permanent set.

C. The line or section thereof to be tested shall be filled slowly with water to expel all air. Hydrostatic pressure shall be applied by pumping water from an auxiliary supply. The test pressure shall be maintained two hours minimum and additional time as required for thorough inspection to find any leaks or defects in the force main and appurtenances. Unless indicated otherwise in Part 4, the test pressure shall be 100 pounds per square inch or 50 percent above the normal operating pressure, whichever is greater. Should the pipe section fail to pass the tests, the Contractor shall find and correct failures and repeat the tests until satisfactory results are obtained.

D. Leakage tests shall be made simultaneously with or following completion of pressure tests of all lines or valved sections thereof. Leakage is defined as the quantity of water added to the pipe under test to maintain the required test pressure for a specified time. The leakage test pressure shall be not less than the maximum operating pressure of the section under test. The duration of the leakage test shall be not less than two hours. Allowable leakage for buried piping shall not exceed 9 gallons per inch of pipe diameter per mile of pipe in 24 hours. For piping not buried, any leakage during the test is unacceptable.

3.09 DISINFECTION OF POTABLE WATER MAINS

A. See disinfection specifications in Section 02555.

B. Disinfection shall be performed by swabbing of new piping and fittings.

3.10 RESERVED

PART 4 SPECIAL PROVISIONS

4.01 PIPING SCHEDULE

A. The following letter designations are used in the Piping Schedule:

Material Designation:

DIP - Ductile Iron Pipe
VCP - Vitrified Clay Pipe
PVC - Polyvinyl Chloride
PPVC - Perforated Polyvinyl Chloride
FRP - Fiberglass
Steel - Steel
SWS - Spiral Welded Steel
CPP - Concrete Pressure Pipe
RCP - Reinforced Concrete Pipe
CPT - Corrugated Polyethylene Tubing

B. Schedule:

Service	Size	Material	Remarks
Potable Water	16x18 Reducer	DIP	Flanged

C. Schedules are not guaranteed to be complete. All piping shown on the Drawings or specified shall be furnished and installed by the Contractor whether or not listed in the above schedule.

END OF SECTION

SECTION 15250

VALVES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing and installing valves, flap gates, and shear gates 4-inch and larger.

B. Floor stands, floor boxes; valve boxes; gears, manual, hydraulic, and electric operators; extension stems; stem guides and supports; brackets; gaskets; bolts and nuts; and other accessories shall be provided as necessary to complete the Work.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Scaled dimensional drawings.

c. Wiring schematics with termination point identification.

d. Piping schematics.

e. Materials of construction.

f. Manufacturer's catalog data.

g. General Arrangement Drawings.

h. Motor information per 11050.

2. Information for the Record:

a. Operation and maintenance information.

PART 2 PRODUCTS

2.01 GENERAL

A. All valves and appurtenances shall be of standard make approved by the Engineer and shall have the name, monogram, or initials of the manufacturer cast thereon. They shall be built and equipped for the type of operation shown on the Drawings, specified herein, or as directed by the Engineer.

B. Opening Direction - Unless otherwise specified in Part 4, valves with screw stems shall open by turning counterclockwise, the direction being indicated by an arrow cast where easily visible to operator.

C. Connections - Valves shall be provided with hubs, spigots, flanges, mechanical groove-type, screw, or other connections compatible with the pipe in which they are installed or scheduled in Part 4.

D. Unless otherwise specified, a stuffing box packed with O-ring seals shall be used to seal the stem of the valve. The seal system used shall be replaceable without removing bonnet or rotating element. Gaskets shall be of either Buna or a rubber composition.

E. Bolts and nuts on buried valves shall be a low alloy steel cathodic to the valve body and having a minimum yield strength of 45,000 psi. All other nuts and bolts shall be low carbon steel conforming with the mechanical and chemical requirements of ASTM A-307, Grade B.

2.02 RESERVED

2.03 RESERVED

2.04 BUTTERFLY VALVES

A. All butterfly valves shall conform to AWWA C504, except as herein modified. The valves shall be suitable for throttling service through the entire operating head range and for the service listed in the Valve Schedule.

B. The butterfly valves shall be equipped with ANSI B16.1 Class 125 cast iron flanges as indicated on the Drawings. Valve bodies shall be cast iron conforming to ASTM A-48, Class 40, or ductile iron ASTM A-536, Grade 65-45-12.

C. Valves shall be AWWA Class 150B short body, unless otherwise specified in Part 4.

D. Rubber seats shall be retained to the body of the valve. Method of retention shall conform to AWWA C504.

E. Valve shafts shall be a continuous, one piece shaft type extending through the valve disc hubs for valves up through the 12-inch size. Valve shafts for valves larger than 12-inch shall be the stub shaft type into the disc hub. Shafts shall be of 18-8 stainless steel.

F. Valve disc shall be cast ductile iron with an 18-8 stainless steel seating edge.

G. The valve shall be equipped with a thrust bearing, other than the seat, to hold the disc in the center of the valve seat.

H. The stem seal shall be either multiple "O-ring" cartridge type or compression type Teflon impregnated packing. The stuffing box shall be designed so that it can be readily repacked and repaired without removing the valve operator.

I. Unless otherwise indicated, operators shall be sized in accordance with AWWA C504 for Class 150B valves. Traveling nut type operators are not acceptable for throttling service.

2.05 AIR AND VACUUM VALVES

A. Air and Vacuum valves shall be used at high in pressurized piping systems subject to cycling to exhaust entrapped air whenever placed under pressure and to allow air to reenter the line to prevent a vacuum from developing. Normal service pressures will be less than 150 psi.

B. Each Air and vacuum valve shall have a body, cover, and baffle constructed of cast iron and a float made of stainless steel. The float seat shall be made of Buna-N material while all other internal parts, such as float guides, bushings, and baffle retaining screws shall be made of high quality stainless steel or bronze.

C. Each unit shall have NPT connections in sizes equal to existing onsite Air/Vacuum Valves. A non-lubricated plug valve of the same size as the air/vacuum valve shall be furnished and installed to allow valve isolation.

1. Taps for the piping connecting the pump to the butterfly valve shall be coordinated by the Contractor.

D. Discharge shall be piped as other air valve currently on site.

E. Air and vacuum valves on the discharge of vertical turbine pumps shall be Well Service by Golden Anderson, or equal.

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 RESERVED

2.10 RESERVED

2.11 RESERVED

2.12 RESERVED

2.13 RESERVED

2.14 RESERVED

2.15 RESERVED

2.16 RESERVED

2.17 RESERVED

2.18 RESERVED

2.19 RESERVED

2.20 ELECTRIC VALVE OPERATOR

A. General:

1. The operator shall be a helical and worm gear type drive by an electric motor.

2. The operator shall be suitable for use on a 480 volt, 3 phase, 60 Hertz power supply and are to incorporate, integral reversing starter, local control facilities, and terminals for remote control and indication connections. The operator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the 3-phase power supply connected to the actuator.

3. It shall be possible to carry out the setting of the torque, turns, and configurations of the indication contacts without the necessity to remove any electrical compartment covers.

4. The operator shall be capable of functioning in an ambient temperature ranging from minus 10 degrees F to 120 degrees F.

5. The operators shall be Rotork Controls, Inc. Model IQM and Model IQ for open-close service or equal.

B. Operator Sizing - The operator shall be sized to guarantee valve closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10 percent below nominal. The operating speed shall be such as to give

valve closing and opening at approximately 60 seconds unless otherwise stated in the specifications.

C. Motor:

1. The electric motor for modulating service shall be Class F insulated and the motor for open-close service shall be Class-F insulated. The motor shall be a suitable rated 4-poled motor.

2. Electrical and mechanical disconnection of the motor should be possible without draining or loss of the lubricant from the actuator gearcase. Plugs and sockets are not acceptable as a means of electrical connection for the motor.

3. Protection shall be provided for the motor as follows:

   a. The motor shall be de-energized in the event of stall when attempting to unseat a jammed valve.

   b. Motor temperature shall be sensed by a thermostat to protect against overheating.

   c. Single phasing protection.

D. Gearing:

1. The operator gearing shall be totally enclosed in an oil-filled gearcase suitable for operation at any angle. All main drive gearing must be of metal construction. For modulating applications the hammer blow backlash shall be omitted from the output gear train. For rising spindle valves, the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator, and the design should be such as to permit the gearcase to be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

2. Standard gear oil shall be used to lubricate the gearcase. Special or exotic lubricants shall not be used as they may be difficult to source in remote locations.

E. Hand Operation:

1. A hand wheel shall be provided for emergency operation engaged when the motor is declutched by a lever or similar means; the drive being restored to power automatically by starting the motor. The hand/auto selection lever should be padlockable in both "Hand" and "Auto" positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in "Hand" without damage to the drive train.

2. The hand wheel drive must be mechanically independent of the motor drive, and any gearing should be such as to permit emergency manual operation in a reasonable time. Clockwise operation of the hand wheel shall give closing movement of the valve unless otherwise stated in the job specifications.

F. Drive Bushing - The operator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bush shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base, should be of the sealed-for-life type.

G. Torque and Turns and Positional Accuracy:

1. Torque and turns limitation to be adjustable as follows:

2. Position setting range - 0.5 to 10,000 turns, with resolution to 15 degrees of operator output.

3. Torque setting - 40 percent to 100 percent rated torque.

4. "Latching" to be provided for the torque sensing system to inhibit torque off during unseating or during mid-travel against high inertia loads.

5. With analogue inputs via the modulating controller, overall accuracy (actuator mechanical output/demand shall be 0.5 percent.

6. The electric circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

H. Remote Valve Position/Operator Status Indication:

1. The operator must provide an Absolute Position Encoder which provides continuous monitoring of valve position during motor or hand wheel operation even when the power supply is not present without the use of a battery to maintain the memory.

2. In the event of a (main) power (supply) loss or failure, the position Encoder must continue to monitor position.

3. If the actuator is not provided with an Absolute Position Encoder, a battery back-up power source must be provided in the actuator to ensure correct remote indication should the actuator be moved manually when the power supply is interrupted. The manufacturer shall provide a recommended maintenance interval schedule on replacement of the battery(s) and associated training for site personnel at no additional cost to the site.

4. The position of the actuator and valve must be stored or updated contemporaneously, even when the power supply is not present.

5. Four contacts shall be provided which can be selected to indicate any position of the valve with each contact selectable as normally open or normally closed. The contacts shall be rated at 5A, 250V AC, 30V DC.

   a. Contact closed when the valve is fully closed.

   b. Contact closed when the valve is fully open.

   c. Contact opened when the valve is about to seat or is fully closed to stop the motor.

   d. Spare.

6. As an alternative to providing valve position, any of the four above contacts shall be selectable to signal one of the following:

   a. Valve Opening or Closing.

   b. Valve Moving (Continuous or Pulsing).

   c. Motor Tripped on Torque in Mid-Travel.

   d. Motor Stalled.

   e. Actuator Being Operated by Handwheel.

I. Local Position Indication:

1. The operator shall include a digital position indicator with a display from fully open to fully closed in 1 percent increments. Red, green, and yellow lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained or stored even when the power to the actuator is isolated.

2. The local display should be large enough to be viewed from a distance of six feet when the actuator is powered up.

3. Operators for modulating service shall have a contactless transmitter to give a 4-20mA analog signal corresponding to valve travel for remote indication. Operators for open-close service shall transmit an open or closed discrete signal.

J. Integral Starter and Transformer:

1. The reversing starter, control transformer, and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation buildup. For Open-Close service, this starter shall be electromechanical type suitable for 60 starts per hour and of rating appropriate to motor size. For modulating duty, the starter shall be solid state and suitable for up to a maximum of 1,200 starts per hour or as required by the application. The modulating service the actuator shall also include dynamic braking. The controls supply transformer shall be from two of the incoming three phases. It shall have the necessary tappings and be adequately rated to power for the following functions:

   a. 120V AC energization of the contactor coils

   b. 24V DC output where required for remote controls

   c. Supply for all the internal electrical circuits

2. The primary and secondary windings shall be protected by easily replaceable fuses.

K. Integral Push-buttons and Selector:

1. Integral to the operator shall be local controls for Open, Close, and Stop, and a local/remote selector switch padlockable in any one of the following three positions:

   a. Local Control Only

   b. Off (No Electrical Operation)

   c. Remote Control plus Local Stop Only

2. It shall be possible to select maintained or non-maintained local control.

3. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

L. Control Facilities:

1. The necessary wiring and terminals shall be provided in the operator for the following control functions:

   a. Removable links for substitution by external interlocks to inhibit valve opening and/or closing.

b. Connections for external remote controls fed from an internal 24V DC supply and/or from an external supply of (minimum 12V, maximum 120V) to be suitable for any one or more of the following methods of control:

1) Open, Close, and Stop.

2) Open and Close - We are using a normally open motor start contact to open the valve when the VFD is called to start and a normally closed contact from the same relay to close the valve when the pump is called to stop. This mode of valve operation would be for Remote control.

3) Overriding Emergency, Shutdown to Close (or Open) Valve from a "Make" Contact.

4) Two-Wire Control, Energize to Close (or Open), De-Energize to Open (or Close).

c. Selection of maintained or push-to-run control for modes (A) and (B) above shall be provided and it shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of approximately 300 ms.

d. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 1.1 kV.

M. Monitoring & Diagnostics Facilities:

1. Monitor (availability) relay, having one change-over contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the "Remote" position to indicate that the actuator is available for remote (control room) operation.

   a. This feature this is to provided but will not be used at current. To be available for future use.

2. Where required, it shall be possible to provide indication of thermostat trip and "Remote" selected as discreet signals.

3. A non-intrusive hand-held computer or software and cables capable of running on a standard laptop PC, capable of duplex communicator for uploading and downloading all variables for the actuator as well as performing detailed diagnostics shall be provided.

4. Provision shall be made for the addition of diagnostic module which will store and enable download of historical actuator data to permit analysis of changes in operator or valve performance.

5. Diagnostic status screens must be provided to show multiple functions simultaneously so troubleshooting can be affected rapidly and efficiently. All diagnostic information should be contained on no more than seven or eight screens so multiple functions can be checked simultaneously.

N. Wiring and Terminals:

1. Internal wiring shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and three-phase power. Each wire shall be clearly identified at each end.
2. The terminals shall be embedded in a terminal block of high tracking resistance compound.
3. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal.
4. The terminal compartment of the operator shall be provided with a minimum of three threaded cable entries.
5. All wiring supplied as part of the operator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.
6. Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards. No more than a single primary size fuse shall be provided to minimize the need to remove single covers for replacement.
7. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of terminal box cover indicating:
    a. Serial Number.
    b. External Voltage Values.
    c. Wiring Diagram Number.
    d. Terminal Layout.
8. This must be suitable for the Contractor to inscribe cable core identification beside terminal numbers.

O. Enclosure:

1. Operator shall be "O-ring sealed, watertight to NEMA 6 minimum, and shall at the same time have an inner watertight and dustproof "O-ring seal between the terminal compartment and the internal electrical elements of the operator fully protecting the motor and all other internal electrical elements of the operator from ingress of moisture and dust when the terminal cover is removed on site for cabling.
2. Enclosure must allow for temporary site storage without the need for electrical supply connection.
3. All external fasteners should be of stainless steel.
4. Operator for explosion/hazardous applications shall in addition be certified flameproof for Zones 1 and 2 (Divisions 1 and 2) Group gases.

P. Startup Kit - Each operator shall be supplied with a startup kit comprising installation instruction, electrical wiring diagram, and sufficient spare cover screws and seals to make good any site losses during the commissioning period.

Q. Performance Test Certificate:

1. Each operator must be performance tested and individual test certificates shall be supplied free-of-charge. The test equipment should simulate a typical valve load and the following parameters should be recorded:

   a. Current at maximum torque setting.

   b. Torque at maximum torque setting.

   c. Flash Test Voltage.

   d. Actuator Output Speed or Operating Time.

2. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.

R. Warranty - Each operator shall be warranted for a minimum of 24 months of operation up to a maximum of 36 months from shipment.

2.21 SHOP PAINTING

A. All iron parts shall be painted before leaving the shop.

B. Unless otherwise specified, all internal ferrous surfaces of each valve except finished or bearing surfaces shall be shop painted with two coats of an asphalt varnish.

C. Unless otherwise specified, all exterior ferrous surfaces of each valve except finished or bearing surfaces shall be shop painted with two coats of a universally compatible primer.

2.22 SOURCE QUALITY CONTROL

A. Each butterfly valve shall be submitted to operation and hydrostatic tests at the manufacturer's plant as specified in applicable AWWA Standards.

B. Other valves shall be tested in conformance with applicable specifications in Part 4 of this Section.

PART 3 EXECUTION

3.01 INSTALLATION

A. All valves shall be carefully installed in their respective positions free from distortion and stress. Connecting joints shall conform to applicable requirements of Section 15210.

3.02 RESERVED

3.03 TESTING

A. All valves shall be tested in place by the Contractor as far as practicable under the conditions for the pipelines in which they are placed, and defects revealed in valves or connections under test shall be corrected at the expense of the Contractor to the satisfaction of the Project Field Representative.

PART 4 SPECIAL PROVISIONS

4.01 VALVE SCHEDULE

A. The following letter designations are used in the Valve Schedule:

Type Designation	Connection Designation	Operator Designation
BV - Butterfly Valve	F - Flanged	M - Motor
Use Designation	**Service Designation**	**Location Designation**
CW - City Water	O-C - Open-Close M - Modulation	PR – Pump Room

B. The Schedule is as follows:

Valve Number	Size (in.)	Type	Connection	Operator	Use	Service	Location
BFV-18	18	BV	F	M	CW	O-C	PR

C. Schedules are not guaranteed to be complete. All valves shown on the Drawings or specified shall be furnished and installed by the Contractor whether or not listed in the above schedule.

END OF SECTION

SECTION 16020

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Wiring schematics with wire termination points identified.

1) Manufacturer's technical product sheets on each component to be furnished.

b. Field testing certificates, signed by the Contractor, certifying that the field tests comply with the requirements specified in Quality Assurance - Part 1.03.

c. Furnish manufacturer's name(s) and catalog numbers.

d. Manufacturer's recommended method of installation for the products to be furnished.

2. Information for the Record:

a. Manufacturer's qualifications, including a list of similar installations.

1.03 QUALITY ASSURANCE

None.

1.04 ELECTRICAL AND CONTROL COORDINATION

A. Layout and installation of grounding system and accessories shall be coordinated with other installations.

1.05 PRODUCT HANDLING

A. Deliver ground wire properly packaged in factory fabricated type containers, or wound on NEMA specified type wire reels.

B. Store grounding materials and ground wire in a 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 tearing wire insulation. Ensure that dielectric resistance of the cable is maintained.

PART 2 PRODUCTS

2.01 MATERIALS

A. Grounding materials shall be corrosion-resistant and chemically compatible with the materials with which they come in contact.

1. Conduit shall be as specified in Section 16130.

2. Conductors for equipment grounding shall be stranded THHN/THWN or XHHW-2, color-coded green. Equipment grounding conductor size shall not be less than that provided in the latest edition of the NEC, or as shown on Drawings, whichever is larger.

B. Use of conduit system for the ground conductor shall not be permitted.

C. Ground rods shall be copper clad and not less than 3/4 inch in diameter and 10 feet long.

D. Connections:

1. In readily accessible locations, compression or bolted connectors of Burndy Engineering Company or equal shall be used.

2. In locations not readily accessible after installation, splices and connections of grounding cable shall be made by exothermic welding process equal to Cadweld.

E. Where an underground ground ring encircling a building or structure is used, it shall be bare, stranded, copper conductor not smaller than No. 4/0 AWG, unless specified or shown otherwise.

F. Ground Enhancement Material (GEM) shall be permanent, maintenance-free, and maintain its earth resistance with time. GEM in its set form shall have a resistance of not more than 20 ohm-centimeters. GEM shall be as manufactured by Erico Electrical Products, or equal.

PART 3 EXECUTION

3.01 COORDINATION

A. Metallic water service pipe, metal frame of a building, concrete encased electrodes, and ground rings surrounding a structure shall be bonded together to form an effective grounding system.

3.02 INSTALLATION

A. System neutrals; secondaries of control power, instrument, metering and relaying transformers; noncurrent-carrying metallic equipment enclosures; exposed metal structures; and supports shall be effectively bonded to ground grids and busses provided under this Contract.

B. Noncurrent-carrying metallic parts, electrical equipment and systems including, but not limited to, transformers, motors, lighting, equipment, raceways, control panels, consoles, panelboards, and cable shields, as well as metallic structures, shall be effectively grounded.

C. Low-voltage electrical equipment, except as otherwise specified, shall be grounded by means of a separate conductor which shall be included in any multi-conductor cable.

D. Electrical continuity of equipment grounding circuits such as metallic raceways shall be assured by bonding where necessary; equipment grounding conductors passing through metallic raceways shall be bonded to the raceways where they enter and leave.

E. Particular care shall be taken to ensure good equipment ground continuity between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

F. Conduits stubbed-up below a floor mounted electrical apparatus shall be fitted with insulated grounding bushings and connected to the electrical apparatus ground bus or

structure. Boxes mounted below floor mounted electrical apparatus shall be bonded to the apparatus ground bus.

G. Insulated grounding bushings shall be used on the grounding of all conduits, 480 volts and higher, with copper grounding conductors.

H. Conduits and raceways, regardless of type and material, shall include a separate insulated equipment ground conductor, whether shown on the Drawings or not, sized no less than required by the latest edition of the NEC or by the Drawings, whichever is larger, and connected to the grounding grid. Each circuit grounding conductor shall be dedicated for that circuit.

I. Connections:

1. Exposed connections shall be made by means of approved grounding clamps. In readily accessible locations, compression or bolted connectors shall be used. Exposed connections between different metals shall be sealed with a synthetic base substance in which zinc particles are suspended such as Burndy Penetrox A-13, Thomas & Betts, (Blackburn) Contax or equal.

2. All buried connections shall be made by an exothermic welding process, "Cadweld", or equal. The tops of all ground rods shall be at least 12 inches below grade.

3. 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 bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

4. Connections at Test Wells: Use compression type connectors on conductors and make bolted and clamped type connections between conductors and ground rods.

5. Compression Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

6. Insulated grounding conductors connected to ground rods or ground buses shall be insulated over the entire area of the connection and sealed against moisture penetration of the insulation and cable.

7. Ground rings shall be in direct contact with earth, buried at a depth of no less than 30 inches, and 20 feet long minimum, unless noted otherwise.

J. Underground Distribution System Grounding:

1. Manholes, Handholes, and Underground Pullboxes: Install 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 No. 1 AWG bare tinned copper conductor from the ground rod into the manhole through a waterproof 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. Seal floor opening with waterproof, nonshrink grout.

2. Connections at Manholes, Handholes, and Underground Pullboxes: Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to the ground rod or ground conductor. Connect circuit ground wire to ground rod. Make connections with minimum No. 4 AWG stranded hard drawn copper wire. Train conductors plumb or level around corners and fasten to manhole or handhole 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.

3. Grounding System: Ground noncurrent carrying metallic items associated with manholes, substations, and pad mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

4. Manholes, handholes and underground pullboxes shall have their metal parts bonded to the equipment grounding conductor of circuit(s) passing through them in accordance with NEC Article 250.

K. Isolated Signal Ground:

1. Where shown on the Drawings, provide a minimum No. 2 AWG stranded, tinned, insulated ground conductor from each control panel or remote I/O panel to a designated system ground point. Ground conductor shall be routed in 3/4-inch Schedule 80 PVC conduit from panel location to system ground connection point. Terminate ground conductor at an insulated, isolated ground bus and at system ground point. Connection at ground rods shall be via exothermic welds.

L. The metal parts of the following nonelectrical equipment shall be grounded: frames and tracks of electrically driven cranes; frames of nonelectrically driven elevator cars to which electric conductors are attached; hand operated metal shifting ropes or cables of electric elevators, and metal partitions, grill work, and similar metal enclosures around equipment of over 750 volts between conductors.

M. All non-current-carrying metal parts of portable equipment and fixed equipment including their associated fences, housings, enclosures, and supporting structures shall be grounded.

3.03 GROUNDING APPLICATIONS

A. Underground grounding conductors shall be bare, tinned, stranded copper except as otherwise indicated.

B. For telephone, alarm, and communication systems, provide a No. 4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location. All grounds in the telephone system shall be bonded together.

C. Separately derived systems required by the NEC to be grounded shall be grounded in accordance with the latest edition of the NEC.

D. Ground metal poles supporting outdoor lighting fixtures to a grounding electrode as indicated in addition to a separate equipment grounding conductor run with supply branch circuit.

E. For all other equipment grounding conductor applications, comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated. Use of conduit system for ground conductor shall not be allowed.

F. Bond the telecommunications grounding electrode to the power grounding electrode using No. 6 AWG copper wire minimum.

3.04 TESTING

A. Comply with Section 16050, "Electrical Testing."

B. Testing shall be by independent electrical testing organization to perform tests described below and in Section 16050.

C. Perform a megger test on the completed grounding system at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminals, and at ground test wells.

1. 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.

2. Perform tests by the two-point method in accordance with IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." Simple moisture addition is not acceptable.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 16030

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the provision of identification of electrical equipment and materials in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Product data for each type of identification product specified.

b. Manufacturer's name(s) and catalog numbers.

c. Nameplate schedule.

1.03 QUALITY ASSURANCE

A. Applicable Standards:

1. Comply with requirements of ANSI Standard, "Scheme for the Identification of Piping Systems" and "Wiring and Equipment Identification" with regard to type and size of lettering for raceway and cable labels

PART 2 PRODUCTS

2.01 NAMEPLATES AND LEGENDS

A. New equipment shall be identified by means of a laminated phenolic nameplate. Modified equipment shall be identified in the same manner as was the original equipment. Equipment whose designation has been changed shall be relabeled as specified or directed.

B. Nameplates shall have white background with black engraved lettering identifying function or equipment designation.

C. Main nameplate on MCC, switchgear, control panel, and other panels shall be 2-inches high by 6-inches wide with 1-inch high letters. Individual nameplates shall be 1-inch high by 3-inches wide with 1/4-inch high letters.

D. Legends shall be completely worded without abbreviations except as approved by the Engineer.

E. Blank nameplates shall be included on all unused components.

F. Nameplates on electrical panels which are fed from a remote source shall include, in addition to their function, where the power originates from (e.g., scum pump panel - fed from MCC-1, MCC-1 fed from main SWG).

2.02 CONDUCTOR IDENTIFICATION

A. Wires and cables, except at lighting and 120 volts convenience outlets, shall be identified by means of tags describing circuit.

B. Tags shall be on all connections, splices, and terminations, and shall also be applied where entering and leaving common wireways.

C. Wire tags shall be equal to Thomas & Betts white, self-adhesive wrap or Panduit heat shrink type labels. Tags shall be vinyl, polyester or Polyolefin, resistant to excessive heat, water, cold, dirt, and grease.

D. The tag type-on-area shall be sufficiently sized to contain five numerals on each line. Wire numbers shall be typed on with Thomas & Betts E-Z Coder Printer, Panduit Dura-Mark Printer or equal.

E. Insulated conductors No. 8 AWG and larger shall be color coded at each end with a 2-inch wrap of suitable color tape as follows, if integral color is not utilized:

System	Phase Conductors A, B, and C	Neutral Conductors
120 volts, single-phase, 2-wire	Black	White
120/240 volts, single-phase, 3-wire	Black and Red	White
208 volts, 3-phase, 3-wire	Black, Red, Blue	--
208Y/120 volts, 3-phase, 4-wire	Black, Red, Blue	White
480 volts, 3-phase, 3-wire	Brown, Orange, Yellow	--
480Y/277 volts, 3-phase, 4-wire	Brown, Orange, Yellow	White
2400 volts, 3-phase, 3-wire	Black, Red, Blue**	--
2400 volts, 3-phase, 4-wire	Black, Red, blue **	White**
4160 volts, 3-phase, 3-wire	Black, Red, Blue**	--
4160 volts, 3-phase, 4-wire	Black, Red, Blue**	White**
4800 volts, 3-phase, 3-wire	Black, Red, Blue**	--
4800 volts, 3-phase, 4-wire	Black, Red, Blue**	White**
Grounding	Green	

** Apply tape near termination on cable.

Tape shall be Scotch #35 in color required above as manufactured by 3M or equal.

F. Direct current conductors shall be identified by the following methods:

1. Provide self-sticking markers on each direct current conductor.
2. Marker colors shall be black letters on "alert orange" background.
3. Each marker shall designate circuit conductor polarity and voltage (e.g. 28 VDC).
4. Direct current control conductors shall be color-coded dark blue.

G. On a 4-wire delta-connected system where the midpoint of one phase winding is grounded to supply lighting and similar loads, the conductor or busbar having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color or by other effective means. Such identification shall be placed at each point on the system where a connection is made if the grounded conductor is also present.

PART 3 EXECUTION

3.01 COORDINATION

A. Submit nameplate schedule for review and approval by the Engineer prior to fabrication of nameplates.

3.02 INSTALLATION

A. Contractor shall furnish and install equipment nameplates, typed panel rosters, wire and cable tags, stenciling, and other identification with text, lettering type, etc., as specified in this Section.

B. Nameplates shall be fastened by means of 3/16-inch diameter roundhead, stainless steel, self-tapping screws. UL 508 4X enclosure nameplates shall be secured with silicon adhesive.

C. Pull, terminal, and junction boxes shall be identified by stenciling the names of the feeders and system wires and cables passing through them.

D. MCCs and power panels of NEMA 3R double-door construction shall have stenciled panel designation at the top and branch designations appropriately spaced in the outer doors. NEMA 4X lighting and power panels shall have designations appropriately placed on them.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 16050

ELECTRICAL TESTING

PART 1 GENERAL

1.01 SCOPE

A. Contractor shall furnish all labor, tools, equipment, and materials necessary to perform electrical testing in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and Section 16010 and shall include:

1. Information for the Record:

a. Certified reports of field tests and observations.

1.03 QUALITY ASSURANCE

A. Testing shall be performed or supervised by the Contractor. Contractor shall be responsible for test records.

B. Contractor shall visually check equipment, wire, phase matching and rotation in preparation for testing.

C. Manufacturer's recommended instructions for testing shall be used when applicable.

D. Testing shall be in compliance with accepted engineering practices, National Electrical Code, and IEEE Standards.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

3.01 COORDINATION

A. Before conducting field tests, the Contractor shall submit to the Engineer a written outline of the methods of testing and equipment to be used.

3.02 FIELD TESTING

A. Required testing shall be completed and written report submitted to the Engineer for acceptance before the Contractor proceeds with subsequent work.

B. Written reports shall be required on tests. Careful records shall be kept of each test and results shall be submitted to the Engineer.

C. Final payment will not be released until all required written test reports are submitted and distributed for information.

D. Contractor shall be responsible for the procurement and installation of compatible components and equipment, and shall perform all work necessary for the proper operation and guarantee of the equipment.

E. Contractor shall make such tests as may be necessary to demonstrate that the work and equipment, as installed, comply with the Contract Documents. When required by the Engineer, such tests shall be performed in the Engineer's presence.

F. Any system or equipment failing to meet the Contract requirements, or to function properly, shall be rectified at the Contractor's expense by readjusting or by removing and replacing the faulty work or equipment, and the tests rerun until the requirements are met.

G. Engineer reserves the right to require the Contractor's equipment be checked by an independent instrument tester.

3.03 CONDUIT TESTING

A. After conduit and accessories have been installed and all concreting operations completed, all conduit runs shall be satisfactorily cleared of all obstructions and foreign matter. Any defects that might damage cable upon installation shall be corrected.

B. Conduits shall be tested, in the presence of the Engineer if requested, by pulling through each conduit a flexible cylindrical mandrel having an outside diameter 1/4 inch less than the inside diameter of the conduit, followed by a stiff wire brush of the same diameter as the conduit. Where conduits installed under this Contract are connected to conduits installed by others, the entire runs between boxes, manholes, or other termination points shall be tested.

C. Contractor shall keep a record, by number, of all conduits tested clear, and shall submit written copies of such record to the Engineer.

D. Defects or stoppages in conduit runs installed by the Contractor shall be corrected. Defects or stoppages in conduit runs installed by others shall be reported to the Engineer, who shall determine the corrective measure to be taken.

3.04 GROUNDS

A. Contractor shall test the ground resistance of the systems.

B. Dry season resistance of each system shall not exceed 5 ohms. If such resistance cannot be obtained with the system as shown, provide additional grounding as directed by the Engineer.

C. Where multiple ground rods are required, they shall be 20 feet apart. The Contractor, in the presence of the Engineer if requested, shall test all made grounds for continuity and resistance. Ground resistance of more than 5 ohms shall be reduced to 5 ohms or less by the use of additional, and properly separated, ground rods, or deep driving of ground rods.

D. In addition, where necessary, Ground Enhancement Material (GEM) shall be used to provide low resistance and high conductivity. GEM shall be installed per manufacturer's recommendations.

3.05 LOW VOLTAGE CIRCUIT BREAKERS

A. Each low-voltage circuit breaker shall be manually opened and closed five times before being energized.

B. Acceptance of each ground fault device will be only on an in-person trip and reset cycle demonstration for the Engineer or his representative - if the Engineer requests to be present. The Engineer shall be notified at least one week before scheduling this test.

3.06 LOW VOLTAGE SYSTEM (INSULATION RATED AT 600 VOLTS)

A. Contractor shall perform insulation resistance testing of 480 volt power feeder circuits with a 500-volt megger.

B. Written test reports of the results shall be submitted to the Engineer prior to final inspection. Equipment which may be damaged during this test shall be disconnected before the test and reconnected upon completion.

C. Upon the completion of each electrical system rated 600 volts or less, but before wiring connections are made to equipment, the Contractor shall test each circuit and each piece of equipment for:

1. Continuity.

2. Grounds.

3. Insulation resistance, phase-to-phase and phase-to-ground, of 480 volts conductors and equipment with a 500-volt megohmmeter.

D. Discontinuities or grounds discovered in low voltage systems shall be corrected before the insulation resistance is measured.

E. Insulation resistance readings, lower than required by good practices or Code, shall be promptly repaired or replaced. Retesting shall be completed until acceptable readings are acquired.

F. Installed control cables and conductor terminations for instrumentation and controls shall be tested for properly grounded cable shields. Control cable shields shall be isolated from ground except at the grounding point. The Contractor shall remove all improper grounds at no additional cost to the Owner. This test shall be witnessed by the Engineer if requested.

G. Following satisfactory completion of circuit and equipment insulation resistance tests, connection of the wiring to equipment, but before it is energized; the tests specified above shall again be carried out.

H. Defective or improperly installed electrical equipment or wiring provided or installed and connected by the Contractor shall be repaired, replaced, or properly installed by the Contractor until it satisfactorily passes the field tests.

I. Irregularities or faulty equipment shall be immediately reported to the Engineer.

3.07 HIGH VOLTAGE SYSTEM (5-35 KV)

A. Contractor shall test 5-35 kV cable after installation, in the presence of the Engineer - if the Engineer requests to be present - and in complete compliance with manufacturer's recommendations and IEEE Standards.

B. Contractor shall test each length of each phase cable in the system, with splices and terminations in place, but disconnected from equipment.

C. The DC test voltage shall be as recommended by the manufacturer and approved by the Engineer prior to test, based on the cable voltage rating specified.

D. The DC test voltage shall be applied by an Associated Research Inc. DC Hypot or equal. A Sola, or equal, constant voltage power supply shall be used with the tester if fluctuations in meter readings are encountered. Test equipment must have a sensitive 0-5 microampere scale.

E. Starting from zero, the voltage applied to the cable shall be increased slowly to limit the charging current being observed on the DC microammeter to less than 50 microamperes. When the test voltage reaches 5 kV, stop and record the stabilized current. Continue raising the voltage, stopping at each 5 kV level, and record the stabilized current reading, up to the maximum test voltage. Maximum test voltage shall not exceed the voltage rating of the cable. Record the current reading each minute over a 5-minute period at each voltage level. The cable test may be terminated at the end of the 5-minute recording period if there is no increase of current during the time period. In all cases, slowly decrease the voltage from the high test voltage before de-energizing the power supply.

F. If during a 5-minute period the current starts to increase or fluctuate, excluding momentary spurts due to supply line disturbances, a faulty circuit is indicated. Check both ends and terminations for cleanliness, recheck all points, and repeat the test as covered above.

G. If the current level continues to fluctuate over the 5-minute period, the sustained test time shall be increased to 15 minutes, with readings being recorded each minute of the period. If at the end of the 15-minute test the current is still fluctuating and/or increasing, the cable test shall be concluded pending retest.

H. Contractor shall measure and tabulate the line voltage of each phase at the load terminals of the main switch or circuit breaker in the building.

I. After HVDC tests, Contractor shall ground conductors for a period of 1 to 4 times the test duration time before they are reconnected to circuit.

3.08 RESERVED

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION

SECTION 16120

CONDUCTORS AND CABLES (600 VOLTS AND LESS)

PART 1 GENERAL

1.01 SCOPE

A. This Section includes 600 volt, single or multi-conductor power or control cable.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's technical product sheets on each component to be furnished.

b. A list of materials needed for construction giving manufacturer's names and catalog numbers.

2. Information for the Record:

a. Manufacturer's recommended method of installation for the products to be furnished.

1.03 QUALITY ASSURANCE

A. Comply with the Insulated Cable Engineers Association (ICEA) and NEMA publications for "Non-shielded Power Cables rated 2000 Volts or Less."

PART 2 PRODUCTS

2.01 MATERIALS

A. Wires shall be identified by surface markings indicating manufacturer's name, conductor size, conductor material, voltage rating, UL Symbol, type designations, and optional ratings.

B. Conductors shall be oil and gasoline resistant.

C. Single conductors for 600-volt power, lighting, and receptacle circuits shall be Type THHN/THWN dual-rated or XHHW-2 and as follows:

1. Conductors shall be stranded, soft-drawn, or annealed copper.

2. Single conductors for general use for power, lighting, and receptacles shall be a minimum size of No. 12 AWG stranded, unless otherwise noted on the Drawings.

3. Minimum wire size for controls shall be No. 14 AWG unless noted otherwise.

4. Single conductors, for power distribution, No. 4 AWG and larger, shall be Type XHHW-2.

5. Single conductors, for power distribution, smaller than No. 4 AWG for use in conduits and ducts shall be Type THHN/THWN dual-rated.

6. Single conductors, for power distribution where exposed to sunlight, shall be listed and marked as sunlight-resistant as manufactured by Okonite, "Okoguard-Okolon" Type RHH or RHW-2 or USE-2, VH-1, or equal.

D. Underground feeder and branch circuit cable for direct burial in earth shall be Type UF, RHW-2, or USE-2 for use in wet or dry locations. Cable shall include a ground wire and be listed and approved for such application.

E. Flexible power cords shall be 3 or 4 conductor including ground, No. 12 AWG minimum wire size, rubber insulated, hard service cord, meeting UL requirements for flexible cord. Flexible power cords shall be rated for 600 VAC and have oil resistant thermoset insulation for use in wet locations (Type SOOW). Ampacity shall be in accordance with NEC Table 400.5(A) and any pertinent derating factors.

F. Flexible control cords shall be 2, 3 or 4 conductor, No. 18 AWG minimum wire size, rubber insulated, hard service cord, meeting UL requirements for flexible cord. Flexible control cords shall be rated for 600 VAC and have oil resistant thermoset insulation for use in wet locations (Type SOOW).

G. All wire and cable insulation and all cable outer coverings shall be listed and approved for the conditions under which the wire or cable is to be used.

2.02 COMPONENTS AND ACCESSORIES

A. Splicing materials shall be as follows:

1. Plastic tape shall be 3M Scotch Electrical Tape No. 33+ or 88, or equal.

2. Neoprene tape shall be Okonite Company "Okoprene", or equal.

3. Insulating putty shall be 3M "Scotchfill Electrical Putty", or equal.

4. Tapes and other splicing materials shall be used only as recommended by the manufacturer, and only if their condition is such as to meet the manufacturer's standards.

5. Heat-shrinkable tubing shall be Raychem or equal.

B. Connectors:

1. Wire connectors for No. 6 AWG and smaller wires shall have sharp internal threading which prevents pulling off, but are removable. Connectors shall be Type Y, Type R, Type G, or Type B, as manufactured by 3M Company or equal.

2. Indentor butt connectors shall be Burndy "Hylinks", or equal.

3. Indentor pigtail connectors shall be Thomas & Betts "Sta-Kon" connectors, or equal, applied to the twisted conductors, and covered with a nylon cap of the same manufacturer.

4. Indentor or compression connectors shall be Thomas & Betts "Sta-Kon" connectors, or equal. The insulation of conductors No. 2 AWG and larger shall be penciled to the diameter of the conductor. Wires connected to screw terminal block points shall have fork tongue lug terminals.

5. Splices to uncut main runs shall be made with Burndy "Crimpits", or equal, for cables No. 4/0 to No. 10 AWG, and Burndy "Hytaps", or equal, for cables larger than No. 4/0 AWG.

6. Cable fittings for armored cable shall be Crouse-Hinds, or equal, and shall be compatible with the cable used as recommended by cable manufacturer.

7. Bus Bar Taps - Bus bars shall be tapped using one of the following connectors.

   a. Two-hole, crimp-type lugs, 600V - 35 kV, sized as required to match bus bar width and conductor in use. Connector metal shall match bus metal. Connector shall be UL listed as manufactured by Thomas & Betts Catalog No. 542XX, or equal.

   b. Heavy duty compression, 600V - 35 kV, sized as required to match conductor in use. Connector metal shall match bus metal. Connector shall be UL listed as manufactured by Thomas & Betts Catalog No. 251-31446-XX, or equal.

C. Power Blocks:

1. All power blocks whether in terminal boxes, motor control, and other locations, shall be equal to Allen-Bradley Bulletin 1492 UL-listed, 600V AC/DC, 3-pole suitable for copper conductors, and rated for 75 degrees Celsius, minimum.

2. Power blocks shall have sufficient current carrying capacity as required, and shall not be adjacent to control wiring terminal blocks.

D. Wire Pulling Lubricants - Pulling lubricants shall be American Polywater Corp. Type J, Ideal Yellow 77 Plus, Thomas & Betts Polymer Base, or equal. Follow manufacturer's recommendations for compatibility with wire insulation, cable jacket, and conduit materials.

2.03 IDENTIFICATION

A. All wires and cables, except at lighting and 120 VAC convenience receptacles, shall be identified by means of tags with wire names. Tags shall be on all connections, splices, and terminations, and shall also be applied where entering and leaving common wireway and at a minimum of 30 foot centers within the wireway. Wire tags shall be as specified in Section 16030.

2.04 FACTORY TESTS

A. Wire shall be tested in accordance with:

1. UL Standard for type THHN/THWN wire and the optional Gasoline and Oil Resistant II listings.

2. UL Standard for Type XHHW-2.

3. UL and ICEA requirements for Type MC Cable.

PART 3 EXECUTION

3.01 COORDINATION

A. Inspect raceways for compliance with specifications and Drawings. Do not proceed with installation until defective conditions have been corrected.

B. Conduit layouts shall provide for cable separation between various systems and between various signals within given systems. The combining of conductors of various systems within one conduit system shall not be permitted.

3.02 INSTALLATION

A. Wiring, above ground, 120 volts and higher, shall be in conduit, wireways, or cable trays.

B. Extreme care shall be used to prevent any injury or damage to the wiring. The Contractor shall observe the installation instructions and precautions issued by the manufacturer of the wire and cable.

C. Cables shall be pulled through conduits in such a manner as not to overstress, stretch, score, cut, twist, or damage the protective covering or insulation of the conductor. If mechanical means are employed for pulling the cables or wires, a dynamometer shall be used.

D. The ends of low-voltage cables installed in damp or wet locations shall be carefully sealed until permanently connected or spliced. The Contractor shall be responsible for maintaining a dry condition while the cables are being pulled.

E. Underground circuit cables for direct burial in earth shall be installed per NEC and IEEE Standards, and as recommended by the cable manufacturer.

F. Keep rocks and rough materials away from direct buried cables.

G. Direct buried cable shall be backfilled with 6 inches of sand over the top of cable to prevent stone bruises and cuts to cable.

H. If single conductor cable is used, space cables evenly at least 6 inches between cable centers. Sand shall be used to fill around cables. Be certain there are no cable crossovers.

I. Cables emerging from the ground shall be installed in conduit from at least 18-in. below grade up to the termination point.

J. Spare conductors or cables shall be individually and uniquely numbered. They shall have sufficient length to reach the farthest termination point within the enclosure. They shall be coiled and stored in a neat and workmanlike manner. The coil shall be tagged to indicate the location of the other end of the spare conductors.

K. All 120 volt "home runs" in excess of 100 feet shall be No. 10 AWG minimum. All 120 volt branch circuits supplying heating, air conditioning, or lighting loads of 1500 Watts or more shall be No. 10 AWG minimum.

L. Conductors in vertical runs shall be adequately supported with approved conductor supports, as outlined in the National Electrical Code.

M. All underground feeder and branch circuit cables for direct burial in earth shall be installed per the National Electrical Code, National Electrical Safety Code Section 35, IEEE Standard 590, and as noted on the drawings and as recommended by the cable manufacturer. Cable shall be installed in an "S-Loop" to allow for ground movement. Backfill trench to provide 18 to 24 inches of cover above the top of the highest wire or cable. Place a 6-inch wide, foil-backed, yellow tape with black lettering reading "ELECTRIC LINE" in the trench, and then complete backfilling operations. Tape shall be Thomas & Betts "E-Z-CODE" NAF-0708, or equal.

N. Conductors No. 12 AWG and smaller shall not be in the same conduit with wires No. 6 AWG and larger.

O. Conductor Combination and Separation:

1. The combining of conductors of various systems within one raceway system shall not be permitted. Raceway layouts shall provide for the cable separation requirements between parallel raceways of various systems, and between various

signals within given systems throughout Division 16 as required. Each of the following shall be maintained in a separate raceway system apart from the others.

a. Lighting and 120 VAC utility.

b. Power Distribution, 600 VAC or less.

c. Power Distribution, greater than 600 VAC.

d. Analog cables for Instrumentation and Control.

e. Motor Branch Circuits.

f. Equipment Controls.

2. Where Motor Branch Circuit conductors are less than No. 4 AWG, they may be combined with related Class 3 motor and equipment control conductors.

3. Fiber Optic Cables may share raceways of other systems except where prohibited by the National Electrical Code.

3.03 SPLICES AND TERMINATIONS

A. Wire and cable lengths shall be continuous and without splices between the points of connection, except as otherwise specified or indicated on the Drawings.

B. Splices and terminations where specified or indicated on the Drawings shall be made in strict accordance with the conductor manufacturer's recommendations.

C. Splices and connections shall have a conductivity and insulation resistance at least equal to that of the cable.

D. Terminated conductors shall be bundled and identified to match approved Contractor submitted drawings.

E. Owner and Engineer may inspect any and all joints before they are taped. If they are taped without being inspected, the tape may be ordered removed from any joint or joints, and the Contractor shall correct any defect found. After inspection and correction of any fault found, the Contractor shall properly retape the joints with new tape.

F. Splices:

1. Dry Locations - No. 6 AWG and Smaller, Single Conductor:

a. Using either an insulated spring or an indentor butt connector shall be followed by wrapping with two half-lapped layers of approved plastic tape extending a minimum distance of 1 inch from the connector.

2. Dry Locations - No. 4 AWG and Larger, Single Conductor:

a. No. 4 AWG conductor and larger shall be spliced using indentor or compression connectors, penciled to the diameter of the connector, and wrapped with two half-lapped layers of approved plastic tape extending a distance from the connector of twice the outside diameter of the larger conductor, or 1 inch, whichever is greater.

b. Splices to uncut main runs shall be made with "Crimpits", or equal, for Cable Nos. 4/0 AWG to 10 AWG, and "Hytaps", or equal, for cables larger than No. 4/0 AWG, and wrapped with two half-lapped layers of approved plastic tape.

c. Electrical insulating putty shall be used as filler before applying tape, where necessary, to provide a smooth taping surface.

3. Wet Locations:

a. Single-conductor, with nonmetallic covering, shall be spliced using either indentor (compression) or insulated butt connectors followed by wrapping with four half-lapped layers of approved plastic tape extending a distance from the connector of twice the outside diameter of the larger conductor or 1 inch, whichever is greater.

b. The insulation of Conductors No. 2 AWG and larger shall be penciled to the diameter of the conductor and wrapped with four half-lapped layers of approved plastic tape extending a distance from the connector of twice the outside diameter of the larger conductor or 1 inch, whichever is greater.

c. Splices in manholes shall only be permitted where specifically shown on Drawings. Where permitted, in manholes, splices No. 4 AWG and smaller shall be in submersible NEMA 6 terminal boxes within easy reach of ground level.

d. Electrical insulating putty shall be used as filler before applying tape, where necessary, to provide a smooth taping surface.

G. Terminations - When connecting conductors at terminals, the following methods shall be used, unless otherwise specified:

1. Indentor or compression terminals shall be applied to the conductor. Terminals shall be held in place at terminal posts or studs with approved locknuts or lock washers.

2. The shields of shielded, multi-conductor control and metering cables, unless otherwise specified by equipment manufacturers, shall be terminated at one end of the cable only.

3. Shield shall be stripped back, intact, applying a compression grounding terminal to the twisted shield, and securely fastening the terminal to the appropriate point on the equipment or device.

4. Shield at the non-terminated end of shielded cables shall be stripped back at least 2 inches beyond the stripped inner conductor's cutoff, and the cable taped with two half-lapped layers of plastic tape where the shield emerges from the outer sheath.

5. Where dead-ending low-voltage wires and cables, the ends shall be insulated and sealed in a manner similar to a standard splice for the particular location and type of wire or cable.

6. All power system terminations shall be phased-out.

H. Where specified, bus bar tapping shall be in strict accordance with bus bar and connectors' manufacturer's recommendations.

PART 4 SPECIAL PROVISIONS

4.01 MEDIUM VOLTAGE SINGLE CONDUCTOR COPPER CABLES

A. Single conductor cables shall have ethylene-propylene rubber, (EPR) 133 percent insulation at 5kV and 15kV. The temperature rating shall be at least 105 degrees C. They

shall be suitable for use in wet or dry locations, indoors or outdoors. These conductors shall be suitable for use in direct burial or underground duct installations.

B. The conductors shall be copper compact stranded per ASTM B-496

C. The strand and insulation screens shall be extruded semiconducting EPR that meets or exceeds the physical requirements of ICEA S-96-639 and AEIC CS8.

D. The insulation shall be EPR, 115 mils thick at 5kV and 220 mils thick at 15kV. Provide 133 percent insulation level for all medium voltage cables.

E. Shielding shall be 5 mil bare copper tapes helically applied with 25 percent overlap around the insulation screen.

F. The outer jacket shall be polyethylene and meet or exceed the requirements of ICEA S-68-516 (5kV) and ICEA S-93-639 (15kV).

G. Cable shall be Okoguard Okoseal Type MV-105, as manufactured by the Okonite Company of Ramsey, NJ, or engineer approved equal.

H. Terminations shall be 3M Type 5600 Quick Term with skirts, is required, by Raychem, or engiuneer approved equal. Termination lugs shall be 2 holes, cast copper compression type T&B 53000 series, or engineer approved equal.

END OF SECTION

SECTION 16121

CONTROL AND SIGNAL CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SCOPE

A. The Section includes the installation of all wire, cable, and terminators for a complete instrumentation and control package.

B. Work shall include but not be limited to the following major items:

1. Communications cable between programmable controller components, processors, graphic interface units, and printers.
2. Communications cable between PLC I/O Panels and programmable controller processors.
3. Programmable controller power supplies to processors and I/O chassis.
4. Analog signal wiring between controls, instruments, equipment, field devices, PLC I/O panels, annunciators, or other instrumentation and control components required to complete the Work.
5. Signal wiring, data highway, fiber optic, conduit materials, and installation not provided under Division 16.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and section 16010 and shall include:

1. Shop Drawings for Review:
   a. A list of materials needed for construction giving manufacturer's names and catalog numbers.
   b. Manufacturer's technical product sheets on each component to be furnished.
2. Information for the Record:
   a. Manufacturer's qualifications.
   b. Certified copies of factory test procedures and results.
   c. Manufacturer's recommended method of installation for the products to be furnished.
   d. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

1.03 QUALITY ASSURANCE

A. The installation of equipment and materials shall conform to the recommendations and instructions of the respective manufacturers of equipment and materials.

B. Fiber-optic cable terminations shall be by certified cable installers. The Contractor shall provide a documented listing of fiber optic cable installation experience.

PART 2 PRODUCTS

2.01 CONTROL CONDUCTORS

A. Control conductors shall, unless noted otherwise on the Drawings, be supplied as single conductor, No. 14 AWG, 19 stranded, 600 volts, 90 degree Celsius of Type THHN/THWN dual rated.

B. Wire shall be supplied in three different integral color codes as follows: brown, orange, and red.

C. Intrinsically safe wiring shall be color coded light blue.

D. Direct current control conductors shall be color coded dark blue.

E. Control wire circuits from external sources shall be color-coded yellow.

2.02 TRANSMITTER CABLE

A. Indoor Use:

1. Cable shall be 2-conductor, No. 16 AWG stranded tinned copper with minimum No. 18 AWG stranded tinned copper drain wire.

2. Cable shall have a 100 percent aluminum foil shield with PVC jacket, rated for 60 degrees Celsius and 600 volts.

3. Cable shall have maximum capacitance of 23 pF (picofarads) per foot between conductors.

4. Cable shall have nominal outside diameter of 0.313 inches.

5. Cable shall be Belden 8719, or equal.

B. Indoor, Outdoor, Transition between Indoor/Outdoor and where subject to damp or wet conditions:

1. Cable shall be 2-conductor, No. 16 AWG stranded, tinned copper with a drain wire. Insulation shall be PVC with a nylon overcoat.

2. Cable shall have a 100 percent aluminum foil shield with PVC jacket, rated for 90 degree Celsius and 600 volts. Jacket shall be sunlight resistant.

3. Cable shall be suitable for direct burial and outdoor applications.

4. Nominal outside diameter shall be 0.294 inches.

5. Cable shall be Belden 1118A, or equal.

C. Inside Control Panels and Connected to Analog I/O Modules:

1. Cable shall be 2-conductor, No. 22 AWG stranded tinned copper with polyethylene insulation, and No. 22 AWG stranded tinned copper drain wire. Color code: Black, Clear.

2. Cable shall have a 100 percent aluminum-polyester foil shield with PVC jacket, rated for 60 degrees Celsius and 300 volts.

3. Cable shall have maximum capacitance of 24 pF (picofarads) per foot between conductors.

4. Cable shall have nominal outside diameter of 0.175 inches.

5. Cable shall be Belden 8761.

D. Transmitter cable shall be identified by the initials "PR".

2.03 RESERVED

2.04 RESERVED

2.05 RESERVED

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 ACCESSORIES

A. Control Wiring Terminal Blocks:

1. Terminal blocks, whether in terminal boxes, motor control components, instrumentation, plant communication system, and other locations, shall be Allen-Bradley Bulletin 1492-W4, or equal, suitable for DIN Rail mounting.

2. Separate terminal strips shall be provided for analog and discrete signal wires, with the discrete terminal strip located on the left side of the enclosure.

3. Terminals shall be provided for cable shields.

4. Terminal blocks shall be identified in accordance with Section 16030.

2.10 SOURCE QUALITY CONTROL

A. Wire/cable shall meet IEEE flame test; UL 1581, "Vertical Tray Flame Test"; and ANSI/NFPA Standard 262-1985 (UL-910) "Horizontal Flame and Smoke Test" requirements.

PART 3 EXECUTION

3.01 COORDINATION

A. Examine raceways and other elements receiving cables for compliance with requirements for installation tolerances and other conditions affecting performance of transmission media.

3.02 INSTALLATION

A. Control wiring shall be identified and tagged per Section 16030.

B. Each wire number shall be "solid", preprinted, and not pieced from single or double digit tags.

C. Wire shall be installed with different color conductor in common conduit, for maximum convenience, with individual conductor identification, which shall be in addition to fiber tag identification as specified herein.

D. The Contractor shall observe the installation instructions and precautions issued by the manufacturer of the wire/cable.

E. Communication cable shall be installed in 1-inch rigid galvanized steel or PVC coated RGS conduit with one cable per conduit.

F. Analog signal cable shall be installed in galvanized rigid steel or PVC coated RGS conduit.

G. No mixing of signal conductors and alternating current voltage conductors shall be permitted within a single conduit.

H. Instrument cable, communication, and analog signal conduits shall be separated a minimum of 12 inches from any alternating current voltage source or conductor.

I. Instrument cable shields shall be grounded to a common ground terminal in the control panel unless device manufacturer recommends otherwise. Shields shall not be grounded at the field device or at any intermediate point.

J. Each programmable controller component shall be grounded to earth ground as well as the cable shield between them. Grounding field wiring shall be in accordance with the manufacturer's recommendations. In no case shall the cable shield be grounded at both ends.

K. Each instrument cable wire shall be identified and terminated at marked terminal strips.

L. Analog instrument cables inside panels shall be justified right as described in Section 16903 and shall terminate at separate terminal strips.

M. Each instrument cable shall be installed in continuous lengths between terminations. No splicing shall be permitted.

N. Twenty percent spare twisted pairs shall be provided in each conduit run between panels where cables serve more than one device.

O. Conductors carrying high voltage and/or high current shall be installed in separate ducts from low power conductors and PLC component cables.

P. All cable (power, instrument, communication) in panels shall have the same physical properties as in the field, to minimize the possibilities of transients.

3.03 SPLICES AND TERMINATIONS

A. Spacing between adjacent terminal strips shall not be less than five inches as measured from the individual terminal block edges.

B. Wire and cable lengths shall be continuous and without splices between the points of connection, except as otherwise specified or indicated on the Drawings.

C. Splices and terminations where specified or indicated on the Drawings shall be made in strict accordance with the conductor manufacturer's recommendations.

D. Splices and connections shall have a conductivity and insulation resistance at least equal to that of the cable.

E. Terminated conductors shall be bundled and identified to match approved Contractor submitted drawings.

PART 4 SPECIAL PROVISIONS

4.01 SPARE PARTS

A. Extra terminal block points shall be provided in the quantity of 30 percent over the quantity used.

END OF SECTION

SECTION 16130

CONDUIT, SURFACE METAL RACEWAYS, AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to provide conduits and surface metal raceways in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and section 16010 and shall include:

1. Shop Drawings for Review:

a. Wiring schematics with wire termination points identified.

b. A list of materials needed for construction, manufacturer's name and catalog numbers.

c. Provide conduit layout drawings. All conduit layouts shall show conduits and conduit types with anticipated number, size, and type of power, control or instrumentation conductors/cables, spares and grounds for each and every section of Division 16 requiring separate conduits. Location of floor and wall penetrations and separation between parallel conduits shall be dimensioned.

2. Information for the Record:

a. Manufacturer's qualifications.

b. Manufacturer's technical product sheets on each component to be furnished.

c. Certified copies of field test procedures and results.

d. Manufacturer's recommended method of installation for the products to be furnished.

e. O & M manuals for equipment provided, including accessories, and maintenance instructions.

f. Manufacturer's recommended spare parts list for the system components and accessories.

g. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

h. Conduit layouts shall consist of "as-installed" drawings showing the exact location and routing of all conduits and conduit duct banks that are installed in or under paved areas, concrete slabs, direct buried, or otherwise concealed.

i. Conduit layouts shall show conduits with number, size, and type of power, control or instrumentation conductors/cables, spares, and grounds for each and every section of Division 16 requiring separate conduits.

j. Copies of certificates issued by the manufacturer of PVC coated rigid galvanized steel conduit to installers who have successfully completed the manufacturer's installation training program.

1.03 QUALITY ASSURANCE

A. Applicable Standards:

1. National Electrical Manufacturers Association (NEMA).
2. Underwriters Laboratories (UL).
3. American Society for Testing and Materials. (ASTM).
4. National Electrical Code (NEC).
5. National Fire Protection Association (NFPA).

1.04 PRODUCT HANDLING

A. Care shall be taken when handling materials. Deformed conduit and surface metal raceway materials shall not be installed. Conduits and surface metal raceways damaged during construction shall be replaced.

PART 2 PRODUCTS

2.01 MATERIALS

A. Metallic Conduit:

1. Metallic conduit, including couplings, nipples, elbows, and bends shall conform to the Standard for Rigid Metallic Conduit of the Underwriters Laboratories, Inc. Accessories such as locknuts and connectors shall be zinc-coated for use with hot-dipped galvanized conduit.
2. Rigid galvanized steel conduit shall conform to Underwriters Laboratories UL-6 Specification, ANSI C80.1, and Federal Specification WW-C581E.

B. PVC Coated Conduit:

1. A plastic coating shall completely encapsulate metallic conduit to provide total protection against corrosion.
2. Conduit shall be galvanized inside and outside, including the threads.
3. Threads shall be coated with urethane over the galvanized threads. A minimum thickness of 40 mil PVC exterior coating shall be permanently fused to the galvanized rigid steel conduit.
4. A urethane or polyurethane interior coating shall be applied at a nominal 2 mil thickness to the interior of the conduit and over the galvanized threads.
5. The PVC coating on all form 8 fittings shall form a gasket-like flange covering the top of the fitting around the opening. All fittings shall have a minimum of 40 mils PVC coating even around the edge of covers.

6. GUA type boxes shall be supplied with WOD type covers. (Feraloy iron instead of aluminum to prevent corrosive reaction between dissimilar metals.)

7. Conduit fittings (couplings, elbows, etc.) shall be of the same material as the conduits and fittings to which they are attached.

8. PVC coated conduit shall be UL listed and conform to the same standards as metallic conduit.

9. PVC coated conduit shall be "OCAL BLUE" as manufactured by OCAL, Inc., "Permacote," "KorKap" or "Plasti-Bond" as manufactured by Robroy Industries, or equal.

10. Conduit shall be supported by corrosion resistant straps and clamps.

C. Polyvinyl Chloride (PVC) Conduit:

1. Conduit shall be a minimum of Schedule 40 for use only when encased in concrete.

2. Concrete encasement for conduits shall be Class B as specified in Section 03300.

3. Schedule 80 shall be used for direct-burial and exposed applications where shown on the Drawings.

4. PVC conduit systems shall conform to Federal specifications WC 1094A, ASTM 512, NEMA TC2 & TC3, and to UL 651 & 514 b. All components shall be "Sunlight resistant" and so marked.

D. Flexible Steel Conduit:

1. Flexible steel conduit shall be liquid tight Appleton Electric Company "Sealtite" or equal.

2. Flexible steel conduit fittings shall be Thomas & Betts, Appleton, O.Z./Gedney, or equal.

E. Flexible Metal Conduit - Flexible metal conduit (Greenfield) shall be used only where indicated on Drawings and approved by the Engineer.

F. Bituminous Coating - All rigid galvanized conduit buried underground shall be coated on the outside with a standard petroleum self-priming asphaltic coating. This material shall meet the requirements of Federal Specification TT-V-51F, Varnish: Asphalt. It shall be free of lead and chromate hazards. This material shall be lead and alkali resistant. PVC coated rigid galvanized conduit shall be exempt from bituminous coating requirement.

2.02 CONDUIT FITTINGS - GENERAL

A. Fittings shall be vapor proof, weatherproof, and explosion-proof where so shown on the Drawings and required by NEC.

B. Fittings for use with Greenfield shall be compatible with the type of conduit, and shall be of the same manufacturer.

2.03 CONDUIT FITTINGS - METALLIC

A. Bushings 1-1/4 inches and larger shall be Type B insulated bushings as manufactured by O.Z./Gedney, Thomas & Betts, or equal.

B. Ground bushings shall be Type BL bushings as manufactured by O.Z./Gedney, Thomas & Betts, or equal.

C. Conduit fittings for use with metallic conduit shall be standard threaded type of cast ferrous construction to suit the location and purpose. Fittings shall be Crouse-Hinds, Appleton Electric, or equal.

D. Covers shall be domed sheet metal, except in corrosive areas, where they shall be cast. All covers shall have gaskets.

E. Exposed fittings, junction boxes, outlet boxes, terminal boxes, etc., shall be cast ferrous material threaded-hub type.

2.04 CONDUIT FITTINGS - PVC COATED

A. Fittings for use with PVC coated conduit shall be compatible with the type of the PVC coated conduit, and shall be of the same manufacturer.

2.05 CONDUIT FITTINGS - PLASTIC

A. Fittings for use with plastic conduit shall be compatible with the type of plastic conduit or duct used, and shall be of the same manufacturer.

B. Adhesives for use with plastic conduit shall be compatible with the type of plastic conduit or duct used and shall be approved by the conduit or duct manufacturer.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate with other work including metal and concrete deck work to interface installation of conduits, surface metal raceways, and support components.

B. Level and square conduits and surface metal raceways and install at proper elevations and heights.

C. Complete the installation of conduits and surface metal raceways before installing any cables or wires.

3.02 OPENINGS AND SLEEVES

A. Electrical penetrations through an exterior surface shall be sealed and made water-tight with a modular mechanical seal of rubber links as manufactured by Link-Seal, O.Z./Gedney, or equal.

B. Electrical penetrations through fire resistance rated walls or floors shall be fire stopped as required by the NEC using the approved method as recommended by the manufacturer. Fire stops (e.g. caulk) shall have a 3-hour, fire-resistance rating, and shall be made by the 3M Company, or equal.

C. Electrical penetrations to hazardous areas shall be gas-tight and fire-stopped using "Link-Seal" FD or FS seals as manufactured by Thunderline Corporation, or equal.

3.03 EXCAVATION AND BACKFILL

A. Excavation and backfill required for the installation of underground conduits shall be done in accordance with Section 02200.

B. Excavation shall not be done until immediately before installation of the specified appurtenances. Cuts shall be done in a workmanlike manner so as to cause the least possible damage.

C. After backfilling, the excavation shall be kept well filled and maintained in a smooth and well-drained condition until permanent surfaces are restored. All surplus excavated material shall be removed and properly disposed of by Contractor.

D. Direct-buried conduit shall be backfilled to provide 18 to 24 inches of cover above the top of the highest conduit.

E. Place a 6 inch wide, yellow, foil-backed, yellow tape with black lettering reading "ELECTRIC LINE" in the trench, and then complete backfilling operations. Tape shall be Thomas & Betts "E-Z-CODE" NAF-0708, or equal.

F. Directional drilling shall be allowed only in areas known to be free of existing underground piping and electrical systems.

3.04 MOUNTING AND ATTACHMENT

A. Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten conduits to concrete bases or structures which are existing, or provided under other sections of the Contract.

3.05 CONDUIT AND FITTINGS - GENERAL

A. Minimum size of conduit shall be 3/4 inch, except that concealed homeruns, underground, and embedded conduits shall not be less than 1 inch.

B. Conduits shall be located for protection from mechanical damage.

C. Conduits shall be sized in accordance with the NEC and based on 40 percent fill based on over two wires, or as shown on Drawings, whichever conduit size is larger.

D. Conduit stub-ups between underground or slab construction and exposed or concealed wall construction shall be elbows of rigid metallic conduit, and shall have an ample coating of asphaltic paint prior to the placement of concrete unless otherwise noted.

E. Conduits with free ends not containing conductors shall be threaded and provided with plumber's caps or with couplings and plugs where flush terminations are required.

F. Flexible connections to all equipment subject to movement or vibration shall be made by means of liquid tight flexible steel conduit equal in length to approximately ten times the diameter of the conduit, but not exceeding 3 feet in length.

G. Conduit runs subject to motion in excess of the capacities of the fittings specified above shall be provided with other approved means of compensating for the motion. Unless otherwise specified or required, expansion fittings shall be installed at the midpoint of their extension.

H. Conduits to pumps or other equipment shall, unless otherwise shown on the Drawings, be routed through or below concrete floor slabs.

I. Runs on floor slabs are not permitted unless specifically shown as such on the Contract Drawings.

J. Conduit runs in poured concrete structures containing expansion joints, approved expansion/deflection joints shall be provided in the conduit. All such expansion joints shall be made watertight. Similar expansion/deflection joints shall be installed wherever conduit crosses structural expansion joints, or is attached to two separate structures, or wherever the conduit run is more than 100 feet in straight length.

K. Where conduit bushings are constructed wholly of insulating material, a locknut shall be installed both inside and outside the enclosure to which the conduit is attached. Ungrounded conductors of No. 4 AWG or larger shall be protected with insulated throat bushings or hubs where entering or leaving an enclosure in conduit systems.

L. Pulling distances shall be limited to a maximum of 200 feet so as not to exceed the wire manufacturer's maximum pulling tensions, and suitable pull boxes, etc., shall be provided whether shown on the Drawings or not.

M. Unused openings in conduit bodies and cast enclosures shall be plugged using Appleton Cat. No. PL6, or equal.

N. The sum of the conduit bend angles between pull points shall not exceed 270 degrees. Bends in conduit containing medium voltage cables shall have a minimum radius of 36 inches.

O. In hazardous areas, all fittings, material, and equipment shall be rigid metallic steel or PVC coated rigid metallic steel.

P. Conduits between hazardous and non-hazardous areas shall include seal-off fittings as required by the NEC and local codes, and the complete installation shall be in accordance with the requirements of such codes.

Q. Seal-off fittings shall be exposed. Sealing compound shall be "Chico" by Crouse-Hinds, or equal. All components and installation in hazardous areas shall conform to the requirements of the National Electrical Code (NEC) and all local codes.

R. Conduits through which moisture may contact live energized parts shall be sealed or plugged at either or both ends per NEC 300.5(G) and 230.8. Spare or unused conduits shall also be sealed. Provide drains and breathers so moisture will not accumulate inside conduit.

S. Conduits subject to motion at right angles to the direction of the run and all conduits in concrete shall be equipped with O.Z./Gedney Type DX, Thomas & Betts, or equal expansion and deflection fittings.

T. Inside surfaces of all conduits shall be free from any imperfection likely to damage conductors or cables during installation.

U. During construction, open ends of conduits shall be capped or plugged to keep out debris. These caps or plugs shall remain in place until wires or cables are pulled through the conduit.

V. Spare conduits and those provided by the contractor for use by others shall have a pull string installed. Coil up at least 24 inches of extra string at each end.

3.06 CONDUIT AND FITTINGS - METALLIC

A. Exposed conduit shall be rigid metallic conduit unless otherwise noted.

B. Rigid metallic conduit shall be installed in true alignment and sloped for drainage wherever necessary; underground conduits shall be drained to manholes or pull boxes.

C. Rigid metallic conduit shall be reamed free from burrs and carefully cleaned before installation.

D. When required, conduit unions shall be provided. Running threads will not be permitted.

E. Conduit fastened directly to structures shall be held with one-hole, malleable iron clamps and clampbacks, or otherwise suitably spaced from concrete or masonry surfaces.

Concealed rigid metallic conduit shall be installed in as direct a line as possible and shall be rigidly supported by approved methods and materials.

F. Exposed rigid metallic conduit shall be installed parallel with or at right angles to the lines of the structure, except as otherwise shown, and supported in an approved manner.

G. Conduits entering a NEMA 3R, 4, 4X, or 12 enclosures shall be installed using watertight fittings of die cast zinc material. Fittings shall be Appleton HUB-XXD, or equal.

H. Expansion fittings shall be installed in all rigid metallic conduit runs which cross expansion joints, and shall be Type AX as manufactured by O.Z./Gedney or Thomas & Betts.

3.07 CONDUIT AND FITTINGS - PVC COATED GALVANIZED RIGID STEEL

A. Polyvinyl chloride (PVC) coated rigid galvanized steel (RGS) conduit shall be installed per the manufacturer's instructions. Only tools approved by the manufacturer of the conduit shall be used.

B. Installers of PVC coated RGS conduit must be certified by the conduit manufacturer to install this type of conduit. Proof of certification shall be furnished to the Engineer.

C. PVC coated RGS conduit shall be used wherever shown on the Drawings by the notation "PVC/RGS", and in all areas where highly corrosive or highly humid atmospheres can exist, whether shown on the Drawings or not. Such areas include, but are not limited to, chemical feed and storage areas, solids storage facilities, wet wells, near the surfaces of standing or running water such as in aeration tanks, digestion tanks, open channels, and clarifiers or settling tanks.

D. PVC coated galvanized rigid steel conduit shall only be used with threaded fittings. Threadless fittings shall not be used.

E. The installation of PVC coated rigid galvanized steel (PVC/RGS) conduit shall conform to the requirements for metallic conduit.

F. Before assembly, field-cut threads shall be coated with an electrically conductive compound approved by the conduit manufacturer.

3.08 UNDERGROUND CONDUIT

A. Underground non-concrete encased conduit shall be installed with a detectable warning tape. If the conduit contains a detectable wire, a warning tape shall still be provided. Underground conduit shall be concrete-encased where shown. The top of underground conduit shall be not less than 30 inches below grade unless otherwise specified. Concrete encasement shall provide a minimum cover of 6 inches on top and bottom, and 6 inches on the sides. Horizontal curves, where necessary, shall be drawn on radii of not less than 6 trade diameters of the largest conduit in the duct bank.

B. PVC conduit and fittings for use in underground duct banks shall be Schedule 40. PVC conduit shall be Schedule 80 where direct-buried.

C. Conduits for concrete-encased duct banks shall be securely held in place by approved window type spacer supports, and shall be laid with joints staggered.

D. The ends of each conduit run which is not to contain wiring under this Contract shall be plugged or capped with manufactured plugs or caps.

E. Conduits shall enter manholes and structures at right angles unless otherwise shown.

F. Conduits shall terminate with a bell end at each manhole entrance.

G. Under pavement conduit crossings shall have a 6 inch minimum concrete cover all around and be reinforced as detailed for a length extending 5 feet on each side of the pavement.

H. Slope for drainage away from building interiors shall be provided. Where inverted elevations are specified, they shall be adhered to, unless the Contractor obtains approval on an alternative layout.

I. Concrete for all underground conduit encased in concrete shall be mixed with five pounds of red dye for each cubic yard of concrete. Red topped concrete shall not be permitted instead of red dyed concrete.

3.09 RESERVED

3.10 RESERVED

3.11 BELOW-GRADE GALVANIZED CONDUIT

A. All rigid galvanized conduit buried underground shall be coated on the outside with a self-priming, standard petroleum asphaltic coating. This coating shall have a thickness when dry of at least 1 mil.

B. The asphaltic coating may be dipped, brushed or sprayed on the exterior surface of the conduit.

C. Before application, surface should be free of grease, oil, dirt, fingerprints, drawing compounds, any other contaminant, and surface passivation treatments to ensure optimum adhesion and coating performance properties.

PART 4 SPECIAL PROVISIONS

4.01 CONDUIT LOCATION SCHEDULE

A. Exterior above grade – RGS.

B. Exterior below grade.

1. In duct bank – Sch40 PVC..

2. Direct bury – SCH 80 PVC.

C. Interior (unclassified) – RGS.

END OF SECTION

SECTION 16230

VARIABLE FREQUENCY DRIVE (VFD)

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install VFDs in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. A list of materials needed for construction, giving quantities, manufacturer's names and catalog numbers.

   b. Manufacturer's technical product sheets on each component to be furnished.

   c. Wiring schematics with wire termination points identified, along with factory wiring and external wiring.

   d. Furnish motor lead lengths, recommended motors, and filters/ reactors.

2. Information for the Record:

   a. Manufacturer's qualifications, including a list of similar installations.

   b. Certified copies of factory test procedures and results.

   c. Manufacturer's recommended method of installation for the products to be furnished.

   d. Manufacturer's recommended spare parts list for components and accessories.

   e. O&M manuals for equipment provided, including accessories, wiring schematics, maintenance instructions, and drive settings, including hard copy and software to access and program drive.

   f. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

1.03 QUALITY ASSURANCE

A. Applicable Standards:

1. Underwriters Laboratories (UL). Provide VFDs which are listed and labeled by UL and comply with applicable UL standards.

2. National Electrical Manufacturers Association (NEMA). Comply with all applicable NEMA standards and guidelines pertaining to VFDs.

3. Institute of Electrical and Electronics Engineers (IEEE). Comply with IEEE Standards for VFDs.

4. National Electrical Code (NEC). Comply with latest edition of the NEC Article 430 related to VFDs.

1.04 PRODUCT HANDLING

A. Handle VFDs and components carefully to avoid breakage, impacts, denting, and scratching units. Do not install damaged equipment. Do not store outdoors or without protection from the weather, unless rated for outdoor use.

1.05 GUARANTEE

A. VFDs shall be warranted by the manufacturer for a minimum of 2 years.

PART 2 PRODUCTS

2.01 MATERIALS

A. VFD enclosures shall be industrial grade, totally enclosed, NEMA 12 rated, fused, or circuit breaker disconnecting means and rated 480V, 3-phase, and 60 Hertz unless otherwise noted.

B. The horsepower rating of the VFD shall be determined by the manufacturer and shall be sized to operate the motor to which it is connected at its nameplate full load amperage.

C. VFD shall have Human Interface Module to be able to check parameters, alarms, and setup. The Human Interface Module shall be visible and accessible from the front of the VFD enclosure.

D. VFD shall have remote control for start/stop/speed etc. as indicated on P&ID drawings or described in the Specifications Part 4.

E. VFD shall include input and output line reactors.

F. VFD shall have a 42,000 amp minimum interrupting capacity when used on a 480V system. Ampere and interrupting capacity ratings shall be as shown on the drawings.

G. VFD shall be horsepower rated as a minimum to handle motor size as shown.

H. VFD shall be totally factory assembled and tested before being shipped.

I. Status and bypass control shall be displayed by LEDs and/or by Human Interface Module.

J. VFD shall have speed control and torque characteristics to match load.

K. VFD(s) shall be Allen-Bradley Powerflex 750 series.

L. VFD shall accept a 4-20 mA DC current input for speed control.

M. VFD shall provide a 4-20 mA DC current output that is directly proportional to its output frequency.

3.02 ACCESSORIES

A. Provide each disconnect device with a padlockable handle. Each operating handle shall be padlockable with as many as three padlocks with a diameter of 3/8 inch.

B. Provide each disconnect switch with two Normally Open auxiliary contacts for remote indication. Auxiliary contacts must be indicative of the state of the switch itself. Therefore, the contacts shall be open when the circuit breaker is open or tripped and closed when the circuit breaker is closed. Contacts shall be wired to terminals for customer use.

C. Provide one 480-120 VAC control power transformer (CPT) with fuses in each primary leg and one secondary leg. The other secondary leg shall be grounded. The CPT shall be sized at least 100 VA larger than the manufacturer's standard size.

D. Provide a 3-position, maintained-action Hand-Off-PLC selector switch mounted on the front of the enclosure. Provide each selector switch with extra contact blocks wired to terminals for customer use. One set of extra contacts shall be closed when the switch is in the Hand position and one set of extra contacts shall be closed when the switch is in the PLC or Auto position.

E. Provide a "Start" and a "Stop" pushbutton switch mounted on the front of the enclosure. The "Start" pushbutton shall be momentary action with Normally Open contacts and a flush head operator colored black or green. The "Stop" pushbutton shall be maintained action, push off/pull on, with a red mushroom head operator.

F. Provide a 2-position, maintained action "Auto/Manual" selector switch on the front of the enclosure. Also, provide a potentiometer on the front of the enclosure for adjusting the output frequency of the VFD when the switch is in the "Manual" position. If the function of this switch and potentiometer can be provided by the interface module provided with the VFD, then the switch and potentiometer will not be required.

G. Provide an auxiliary control relay with two SPDT contacts and 120 VAC coil. This relay shall be controlled by the Start/Stop pushbuttons mounted in the enclosure front and any similar field mounted devices when the 3-position selector switch is in the "Hand" position.

H. When the 2-position selector switch is in the "Auto" position the output frequency of the VFD shall be controlled by a 4-20 mA DC signal provided by the plant control system. The VFD shall also provide a 4-20 mA DC signal output for remote frequency verification.

I. The VFD shall provide contacts wired to terminals for customer use for the following signals: "VFD Running" and "VFD Fault".

J. The VFD shall accept a "Start/Stop" contact closure signal from the Plant Control System to control its run status when the 3-position selector switch is in the "Auto" or "PLC" position.

PART 3 EXECUTION

3.01 COORDINATION

A. Fuses or circuit breaker shall be sized per manufacturer's ratings. Contractor shall confirm drive size to match with equipment size before ordering. Contractor shall exercise caution when checking motor rotation (or bumping motor) so as to prevent nuisance fuse blowing or damage to the drive.

3.02 INSTALLATION

A. VFDs shall be wall/rack mounted or floor mounted depending on the size of the VFD and the mounting arrangement from the manufacturer. Mount VFD to allow access for incoming feeds, outgoing motor leads, and all equipment in the VFD. Follow manufacturer's installation instructions.

B. VFDs shall be easily accessible to check fuses and other components for function and continuity.

C. All floor-mounted VFDs shall be mounted on 4-inch high concrete housekeeping pad provided by the Contractor.

3.03 TESTING

A. Prior to energizing VFDs, test wiring for electrical continuity and for short circuits. Ensure proper polarity of connections is maintained and that fuses are checked for continuity and installed properly. Check motor rotation after checking with Engineer for direction and motor coupling.

B. Check that grounding is properly installed in accordance with manufacturer's recommendations and the NEC.

C. The setup and checking of the VFDs shall be included with the drive for the initial field startup, unless otherwise noted. This will include one trip for two days to set up and test drive and include at least 4 hours for training.

PART 4 SPECIAL PROVISIONS

4.01 ACTIVE HARMONIC FILTER

A. Provide a 150A, 480V active harmonic filter in a UL Type I enclosure.

1. For the VFD noted in this specification, the active harmonic filter shall be TCI Part No. ALC 150A 01H00 with HMI TCI Part No. CM150A01 and 1200/5 current transformer TCI Part No. KCTF1200A to be installed on a 1600A, 480V switchboard bus.

END OF SECTION

SECTION 16251

SURGE PROTECTIVE DEVICES (SPD)

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing surge protective devices (SPD) and related equipment in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Submit manufacturer's technical product sheets on each component to be furnished, giving conductor size, type and length, dimensions, manufacturer's name and catalog numbers.

b. Submit prototype test results of proposed equipment indicating short circuit current rating (SCCR) and compliance with UL requirements indicating a nominal discharge rating of 20 kA.

2. Information for the Record:

a. Manufacturer's recommended method of installation for the products to be furnished.

b. Operation and Maintenance Manuals.

1.03 QUALITY ASSURANCE

A. Materials described herein shall be furnished by a single supplier who shall be responsible for the performance of the equipment in its entirety. The responsibility shall not be split among suppliers of individual components.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.

C. Manufacturer shall provide documentation showing the SPD meets the requirements of UL1449, 3rd Edition.

1.04 GUARANTEE

A. Manufacturer shall provide a minimum of a ten year replacement warranty for any SPD part failure.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Unit shall have an engineered solid-state high performance suppression system, utilizing arrays of fused nonlinear voltage dependent metal oxide varistors with similar operating characteristics.

B. Suppression system platform shall be balanced to provide equal impedance paths for surge currents to ground, in a seamless low stress manner ensuring maximum performance.

C. The unit shall have a maximum continuous operating voltage (MCOV) rating of 115 percent of the system's nominal operating voltage. The MCOV shall be a tested value as defined in Section 377.3 of UL1449, 3rd Edition.

D. Units for wye configured electrical systems shall have directly connected suppression elements between line-line, line-neutral, line-ground, and neutral-ground.

E. Units for delta configured electrical systems shall have suppression elements between line-line and line-ground.

F. Units for Split Phase, 3 wire plus ground configured electrical systems shall have suppression elements between line-line, line-neutral, line-ground and neutral-ground.

G. Units for 3 Phase, High Leg Delta, 4 Wire plus ground configured electrical systems shall have suppression elements between line-line, line-neutral, line-ground, neutral-ground, high line-neutral and high line-ground.

H. SPD shall have a high-performance noise rejection filter. Attenuation for electric line noise shall be minimal per UL standards.

I. Units shall not consist of plug-in type modules or printed circuit boards as surge current conductors. All internal components shall be hardwired with connections using low impedance conductors or copper bus and compression fittings.

J. Unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit. Service Entrance units shall include a surge counter alarm and dry contact output for remote alarm indication.

K. Service Entrance Unit shall incorporate an integral test point allowing easy off-line diagnostic testing to verify the operational integrity of the unit's suppression/filter system.

L. Provide enclosure of NEMA 12 rating unless shown otherwise on the Drawings or in Part 4 of this Specification.

M. SPD shall be as manufactured by Eaton Innovative Technologies, Surge Suppression, Inc., APT, or equal.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate with other work, including painting, and electrical boxes and wiring work as necessary to interface orderly installation of all work.

3.02 INSTALLATION

A. Verify that neutral to ground bond is present and voltage form neutral to ground is less than 5 VAC on three phase wye, split phase and high-leg delta systems.

B. Install SPDs as indicated in the manufacturer's written instructions and other recognized industry practices.

C. Install SPD as close as practical to the device to be protected in accordance with applicable manufacturer's instructions and local or national code requirements.

D. Connections shall be with low impedance bus or minimum No. 8 AWG, copper conductor. Leads shall not be any longer than necessary, avoid unnecessary bending of conductors.

E. Ground SPD per manufacturer's recommendations and in accordance with Section 16020.

F. If permanently attached leads provided with the SPD need to be extended, in-line butt splices shall be used. Connectors, such as wire nuts, that introduce a pointed connection are not acceptable.

3.03 INSPECTION, STARTUP, AND TRAINING

A. Demonstrate that the SPD is installed correctly and functioning properly prior to energizing equipment to be protected.

B. Contractor shall provide four hours of field training to Owner by a factory trained representative on proper procedures to operate diagnostic test equipment. Coordination of this training shall be made with Owner's schedule.

PART 4 SPECIAL PROVISIONS

4.01 SURGE PROTECTIVE DEVICE SCHEDULE

A. The following schedules are intended to aid the Contractor in identifying SPD location and rating. It is intended to supplement the Drawings and Specifications and is not guaranteed to be complete. All SPD shown on the Drawings shall be furnished and installed by the Contractor whether listed in the schedules or not.

B. The rating of the SPD for the service entrance disconnect shall be rated at least 150,000 Amps per Phase. SPD for service entrance overcurrent protective devices rated above 2000 Amps shall be based on the table below this section.

C. The rating of the SPD for Motor Control Centers, Power Panels or Switchgear downstream of the main service entrance disconnect shall be based on the following tables below this section.

Main Overcurrent Protective Device	Amps Per Phase
0 – 800 Amps	50 kA
801 – 2000 Amps or Service Entrance	150 kA
2001 – 4000 Amps	200 kA
Greater Than 4000 Amps	300 kA

Location	ID Tag	Voltage	Phase	No. Of Wires	Main Overcurrent Protective Device	NEMA Enclosure*
Pump Room	Pump Room	480	3	3		1

D. The SPD for Lighting Panels shall have 48,000 Amps per Phase protection and be the Sine Wave Tracking type.

Location	ID Tag	Voltage	Phase	No. Of Wires	Main Circuit Breaker	NEMA Enclosure*

* SPD's if mounted in separate enclosure inside Motor Control Centers, Power Panels, Lighting Panels or Switchgear by the manufacturer shall have the same enclosure rating as the equipment they are installed in.

END OF SECTION

SECTION 16320

MEDIUM VOLTAGE FUSES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing fuses rated between 2,400 - 34,500 volts in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings:

a. Manufacturer's technical product sheets on each component to be furnished.

b. Manufacturer's name(s) and catalog numbers for all fuses.

2. Information for the Record:

a. Time/current characteristic trip curves for each fuse rated above 60 amperes.

b. Manufacturer's test reports and certification for materials provided.

1.03 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.

B. Applicable Standards:

1. Listing and Labeling Agency Qualifications:

a. Comply with a "Nationally Recognized Testing Laboratory" (NRTL) as defined in Occupational Safety and Health Administration (OSHA) Regulations.

1.04 PRODUCT HANDLING

A. Deliver fuses properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage.

B. Store fuses 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 fuses carefully to prevent physical damage. Do not install damaged fuses. Remove from site, and replace damaged devices with new.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor shall provide a complete set of current limiting fuses wherever fuses are indicated, or required.

B. Fuses shall be sized per fuse manufacturer's tables for short circuit protection.

C. Primary medium voltage fuses (2,400 - 34,500 VAC)

1. Fuses shall be current limiting, and sized per fuse manufacturer's tables for short-circuit protection and proper coordination with main secondary protection devices.

2. Fuses shall be "E-rated" for transformers and feeders, and "R-rated" for motor protection.

3. Fuses shall have an open fuse indicator.

4. Fuses shall be as manufactured by S & C Electric Co, or equal.

D. Special fuses shall be furnished exactly as provided by the equipment manufacturer with no substitutions permitted.

2.02 LABELS

A. Install labels inside enclosure identifying the type of fuse installed, its ratings and the UL class.

PART 3 EXECUTION

3.01 COORDINATION

A. Contractor shall be responsible for verifying fuse size (shown or not) to properly coordinate with the equipment provided including cable protection before ordering fuses.

B. Install wiring between fuses and control/identification devices as specified in other sections.

3.02 INSTALLATION

A. 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.

B. Locate independently mounted fuses and install in accordance with manufacturer's written installation instructions.

C. Fuses shall be installed such that the label and indicator are visible from front of the fuse holder.

3.03 IDENTIFICATION

A. Identify components in accordance with Section 16030 "Electrical Identification."

3.04 TESTING AND INSPECTION

A. Inspect for defects and physical damage, Nationally Recognized Testing Laboratory (NRTL) labeling, and nameplate compliance with current single line diagram.

B. Fuses blown during construction and start-up shall be replaced by the Contractor at no additional cost to the Owner.

PART 4 SPECIAL PROVISIONS

4.01 SPARE PARTS

A. Spare fuses shall be provided and delivered to the Owner as follows:

1. Primary fuses shall be provided with one set of spare fuses for each set of primary fuse holders.

END OF SECTION

SECTION 16351

DRY TYPE PAD MOUNTED TRANSFORMERS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing three phase pad mounted oil filled and dry-type distribution transformers with primary voltages greater than 600 VAC of the two-winding, self-cooled type, complete and in place, ready for service.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. General arrangement drawings, kVA rating, primary and secondary voltage, impedance.

b. Wiring schematics and termination identifications

c. Manufacturer's data sheets including all maintenance data, No-load sound level, Full-load sound level, temperature rise, No-load losses and Full-load losses.

2. Information for the Record:

a. Manufacturer's qualifications

b. Manufacturer's storage and handling requirements

c. Equipment acceptance test procedures

d. Certified factory test reports

e. Sound level test reports

f. Field test reports

g. Equipment warranty

h. O&M manuals

1.03 QUALITY ASSURANCE

A. Transformers shall be designed, constructed, rated, and tested in accordance with UL, NEMA, ANSI, IEEE, NFPA, and OSHA standards.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years.

C. Manufacturers shall be registered firms in accordance with ISO 9001:2000; which includes the design and manufacture of medium voltage oil-filled or dry-type power, and distribution transformers.

1.04 PRODUCT HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. A copy of these instructions shall be included with the equipment at the time of shipping.

1.05 GUARANTEE

A. Transformers shall be warranted against defects in materials, workmanship, and performance for two years after the date of substantial completion.

PART 2 PRODUCTS

2.01 RESERVED

2.02 RESERVED

2.03 RESERVED

2.04 DRY-TYPE PAD-MOUNTED TRANSFORMERS

A. The transformer(s) shall be compartment type, non-ventilated, self-cooled, Class ANV, for mounting on a pad and shall comply with the latest applicable standards.

B. The transformer(s) size (kVA), primary and secondary voltages shall be as listed in Part 4 of this specification.

C. The transformer(s) shall be designed to operate at a frequency of 60 Hertz.

D. There shall be two 2.5 percent full capacity above normal and two 2.5 percent full capacity below normal taps.

E. Impedance shall be manufacturer's standard plus or minus 7.5 percent manufacturing tolerance.

F. The Basic Impulse Level (BIL) for secondary voltages of 600 volts or less shall be 30 kV. All primary voltages and other secondary voltages shall be according to the following table.

kV Class	BIL (kV)
1.2	30
2.5	45
5.0	60
7.2	60
8.7	95
15.0	95
25.0	125

G. The self-cooled sound rating shall be based on the following table.

kVA Rating	Self-Cooled Rating (dB)	kVA Rating	Self-Cooled Rating (dB)
225	58	2000	66
300	58	2500	68
500	60	3000	68
750	64	3750	70
1000	64	5000	71

H. The transformer(s) shall have an average temperature rise of 80/100 degrees C above a 40 degrees C maximum ambient temperature, 30 degrees C average ambient.

I. The coils shall be wound with copper conductors. The high and low voltage windings shall be cast in epoxy using a mixing and vacuum casting process to ensure the absence of voids. Casting epoxy shall completely encapsulate the coil and oven baked to fuse the conductors into a rigid sealed coil.

J. All insulating materials are to be in accordance with IEEE Standard C57.12.01 for 220 degrees C UL insulation system.

K. All cores to be constructed of high grade, grain-oriented, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. Laminations shall be free of burrs and stacked without gaps.

L. The core and coil assembly shall be virtually impermeable to moisture, dust, salt air and other industrial contaminants.

M. The transformer shall be mounted in a heavy gauge enclosure consisting of three isolated sections; high voltage compartment, low voltage compartment, and transformer compartment. The enclosure is to be of NEMA Type 3R rated rain-resistant construction. Indoor enclosures with weather shields are not acceptable.

N. Vibration dampening isolation pads shall be installed by the manufacturer between the core and coil and the enclosure..

O. The high and low voltage compartments shall be located side by side, separated by a steel barrier. When facing door side of the transformer, the low voltage compartments shall be on the right. Terminal compartments shall be full height, air-filled, with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened. The low voltage door compartment shall have 3-point latching and padlocking provisions.

P. The high voltage terminations and equipment shall be dead front.

Q. Dead front bushings shall be either universal wells or one-piece integrated for use with separable connectors.

R. The enclosure base is to be constructed of structural steel members to permit rolling or skidding in any direction. The base shall also be provided with lifting devices and jacking pads designed to be flush with the enclosure.

S. Access to the transformer section is to be through a removable panel with padlock hasps to prevent entry by unauthorized personnel when padlocks are installed.

T. Metal-oxide, gapless-type distribution class lightning arresters shall be installed by the manufacturer on the high voltage side of the transformer to provide additional protection against high voltage lightning or switching surges.

U. Transformer sound levels shall be warranted by the manufacturer not to exceed the values specified in IEEE Std. C57.12.01.

V. Transformers shall be UL listed.

W. Transformers shall be manufactured by Square D, Cooper, Cutler-Hammer, Siemens, or equal.

2.05 DRY-TYPE ACCESSORIES

A. Transformer located indoors subject to moisture shall have weather shield.

B. Transformers located outdoors shall have ventilated NEMA 3R tamper-resistant enclosure.

C. Transformer in corrosive area indoors or outdoors shall have stainless steel enclosure.

D. Stencil painted on outside of transformer with kVA rating, voltages, and impedance.

2.06 DRY-TYPE SOURCES QUALITY CONTROL

A. Tests shall be conducted in accordance with the provisions of IEEE C57.12.91 and shall include, as a minimum, the following tests:

1. Ratio
2. Polarity
3. Phase Rotation
4. No-Load Loss
5. Excitation Current
6. Impedance Voltage
7. Load Loss
8. Applied Potential
9. Induced Potential
10. QA Impulse Test
11. Temperature Test (typical data from previous unit is acceptable)
12. Sound Test (typical data from previous unit is acceptable)

PART 3 EXECUTION

3.01 COORDINATION

A. Provide concrete pad(s) in accordance with Section 03300.

B. Anchor transformer to pad with Type C expansion anchors in accordance with Section 05500.

3.02 INSTALLATION

A. All transformers shall be installed according to manufacturer's instructions and NEC Article 450.

B. Tighten all lugs to manufacturer's specifications, and adjust transformer taps to provide secondary voltage to within 2 percent of nominal system rating.

3.03 INSPECTION START UP AND TRAINING

A. Conduct the following performance tests.

1. Measure primary and secondary winding resistance for shorted or open windings.
2. Measure secondary voltage for proper tap settings.
3. Measure impedance from neutral to ground.

B. Submit written report of test results to Engineer.

PART 4 SPECIAL PROVISIONS

4.01 TRANSFORMER SCHEDULE:

A. Transformers shall be identified as to their location, type, size, voltages, enclosures, and accessories as per the following schedule.

Location	ID Tag	Type	Size kVA	Primary Voltage	Secondary Voltage	Primary Left/Right	Enclosure
Outdoor		Dry	1000	2400	480 Wye	Left	3R/T

Type:
OIL = Oil-Filled
DRY = Dry-Type
Enclosures:
1 = NEMA 1
3R = NEMA 3R
4X = Stainless Steel

END OF SECTION

SECTION 16411

SWITCHBOARDS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install switchboards in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Submit 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.

b. Submit shop drawings of spare fuse cabinet showing material, dimensions, and features including storage provisions for fuse cartons.

c. Submit schedule of features, characteristics, ratings, and factory settings of individual protective devices.

d. Furnish manufacturer's name(s) and catalog numbers.

e. Furnish manufacturer's technical product sheets on each component to be furnished.

2. Information for the Record:

a. Operation and Maintenance Manuals.

b. Panel Schedules

B. Upon completion of the installation and acceptance by the Owner and Engineer, all electrical (schematic) diagrams, interconnection diagrams, panel layouts, and related support materials shall be corrected and amended to reflect the installed system.

1.03 QUALITY ASSURANCE

A. Work shall be in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and specifications.

B. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.

C. Equipment and material shall be furnished by an established, reputable manufacturer, shall be of top-quality construction, design, and shall be guaranteed to perform the service required.

D. Applicable standards:

1. National Electrical Code (NEC).

2. National Electrical Manufacturers Association (NEMA).

3. Underwriters Laboratories, Inc. (UL).

E. Field Testing Organization Qualifications: To qualify for acceptance, the testing organization must demonstrate, based on evaluation of organization submitted criteria conforming to American Society for Testing and Materials (ASTM) E699 that it has the experience and capability to conduct satisfactorily the testing indicated.

F. 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.

1.04 PRODUCT HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to assure 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.

1.05 GUARANTEE

A. The Contractor shall warrant the completed system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of the completed and certified test or from the date of first beneficial use.

PART 2 PRODUCTS

2.01 MATERIALS:

A. 480V Switchboard: Furnish and install, as shown on the Drawings, a service and distribution switchboard as specified herein, for a 480 volts, 3 phase, 4 wire system, unless noted otherwise.

B. The switchboard enclosure shall be NEMA 1 indoor construction. Switchboard shall be of the modular type construction with the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top, and rear shall be covered with removable screw-on code-gauge steel plates.

1. Switchboard shall include all protective devices and equipment, as listed on drawings, with necessary interconnections, instrumentation, and control wiring.

2. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips.

3. Switchboard shall be constructed in accordance with the latest NEMA PB-2 and UL 891 standards.

C. The bus shall be silver plated copper of sufficient size to limit the temperature rise to 65 degrees C, based on UL tests. The bus shall be braced for 50,000 amperes symmetrical, and supported to withstand mechanical forces exerted during short-circuit conditions when directly connected to a power source having the indicated available short-circuit current.

1. The through bus on the end section shall be extended and pre-drilled to allow the addition of future sections with standard splice plates. Grade 5 bolts will be used at bus joints. Ground bus and lugs shall be furnished.

2. Ground bus shall extend the entire length of the switchboard, and shall be firmly secured to each vertical section.

D. Individual sections shall be front accessible and the rear of all sections shall align. Incoming line termination, main device connection, and all bolts used to join current-carrying parts, shall be installed so as to permit servicing from the front only so that no rear access is required. The branch devices shall be front-removable and panel-mounted, with line and load side connections front accessible.

E. The main protective device when indicated, to be installed in the main device section, shall be a quick-make, quick-break, trip-free, heavy-duty type molded-case circuit breaker. It shall be a 3-pole 600-volt breaker with a trip current rating as indicated on the drawings and an interrupting capacity of not less than 50,000 amperes RMS symmetrical, at the system voltage.

F. All branch circuit molded-case circuit breakers, shall be of quick-make, quick-break, trip-free thermal-magnetic type, with frame, trip, and voltage ratings, 3-pole, as indicated on the plans. All breakers shall have an interrupting capacity of not less than 50,000 amperes RMS symmetrical at the system voltage. All breakers shall be removable from the front of the switchboard without disturbing adjacent units.

G. A ground-fault protection system shall be included when indicated on the Drawings. It shall consist of:

1. An adjustable current sensor enclosing all phase and neutral conductors of the circuit to be monitored (zero sequence method).

2. Appropriate relaying equipment to provide the desired ground-fault current sensitivity and time-current response characteristics.

3. A fusible, bolted pressure-contact switch equipped to function in conjunction with the other elements of the ground-fault protection system.

4. Installation of the equipment shall, in all respects, be in accordance to the manufacturer's recommendations.

H. Switchboard, circuit breakers, and power meter shall be as manufactured by Eaton, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install switchboards and accessory items in accordance with manufacturers' written installation instructions.

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. Provide and install housekeeping pads for all switchboards.

D. Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

E. 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.

F. Tighten grounding connections to comply with tightening torques specified in UL Standards 486A and 486B.

G. Ground equipment to main electrical ground bus indicated. Provide maximum 5-ohm ground resistance at switchboard location.

H. Tighten switchboard bus join 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.

3.02 IDENTIFICATION

A. Comply with Section 16030, "Electrical Identification."

B. Identify field-installed wiring and components and provide warning signs.

C. Identify units, devices, controls, and wiring with factory applied labels and signs.

D. Compartment nameplates shall be engraved laminated plastic for each compartment, mounted with corrosion resistant screws.

3.03 INSPECTION, START-UP, AND TRAINING

A. Comply with applicable standards of the International Electrical Testing Association (INETA) including Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."

B. Pretesting: Upon completing installation of the system, perform the following preparation for tests:

1. Make insulation resistance tests of switchboard buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests for 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.

C. Quality Control Testing Program: Conform to the following:

1. Program objective: to assure switchboard installation meets specified requirements, is operational within specified tolerances, provides appropriate protection for systems and equipment, and is suitable for energizing.

2. 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 the Engineer or Owner at least one week in advance of test commencement.

4. Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of adjustments and remedial efforts.

5. Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, person responsible, and date.

D. 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 valves.

6. Clean switchboard interior and exterior using manufacturer's approved methods and materials.

7. Perform visual and mechanical inspection and related work for circuit breakers.

E. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.04 PROTECTION

A. Apply temporary heat in accordance with manufacturer's recommendation within each section of switchboards throughout periods during which the switchboard is not in a space that is continuously under normal control of temperature and humidity.

PART 4 SPECIAL PROVISIONS

None.

END OF SECTION