

# TECHNICAL SPECIFICATIONS

<b>Section Number</b>	<b>Title</b>
01010	SUMMARY OF WORK
01020	ALLOWANCES
01055	CONSTRUCTION STAKING
01060	CODES AND STANDARDS
01150	MEASUREMENT AND PAYMENT
01300	SUBMITTALS
01500	CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
01620	STORAGE AND PROTECTION
01625	GENERAL EQUIPMENT AND REQUIREMENTS
01700	CONTRACT CLOSEOUT
01710	CLEANING
01720	RECORD DOCUMENTS
01740	WARRANTIES AND BONDS
02000	GENERAL CONSTRUCTION REQUIREMENTS
02125	EROSION CONTROL FOR INFRASTRUCTURE PROJECTS
02667	TESTING OF PRESSURE PIPELINES
02936	GRASSING
03200	CONCRETE REINFORCEMENT
03250	CONCRETE JOINTS AND JOINT ACCESSORIES
03300	CAST IN PLACE CONCRETE
03350	CONCRETE FINISHES
03600	GROUT
05120	STRUCTURAL STEEL
05500	MISCELLANEOUS METALS
07050	PROCESS PIPING HEAT TRACING
07051	PROCESS PIPING INSULATION
09900	PAINTING
11260	ONSITE SODIUM HYPOCHLORITE GENERATION SYSTEM
11270	BRINE TANK
15064	POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS
15094	PIPE SUPPORTS AND HANGERS
15095	WATER UTILITY DISTRIBUTION PIPING AND VALVES

SECTION 01010  
SUMMARY OF WORK

1 GENERAL

1.1 DEFINITIONS

- A. Definitions for common terms used in these documents are provided in Article 1, General Conditions/Supplemental Conditions.

1.2 SUMMARY

- A. The work to be performed consists of furnishing all labor, equipment, tools and materials required to construct the Gees Mill Water Treatment Plant (WTP) Hypochlorite Generation and Brine Storage Modifications and associated utilities, as set forth in the Bid Form, as shown on the Drawings and as specified herein. In general, the work includes modifications of the existing hypochlorite generation system and required site work.

1.3 GEES MILL WTP HYPOCHLORITE GENERATION

- A. The Gees Mill WTP where this project is located is near the eastern border of Rockdale County, located at 3090 Gees Mill Road, Conyers, GA 30013. The primary purpose of this project is to provide additional brine storage and on-site sodium hypochlorite generation capability. The work at the Gees Mill WTP Hypochlorite Generation and Brine Storage Modifications can generally be described as consisting of:

1. Site preparation including grading and erosion, sedimentation, and pollution control.
2. Preparation of subgrades and foundation support, including the removal of unsuitable materials.
3. Furnishing and installation of a cast-in-place concrete foundation and equipment pad for the proposed brine storage tank.
4. Furnishing and installation of new brine storage tank and replacement of the existing brine storage tank, including installation of all required water feed piping, brine solution piping, salt fill piping, and access platform.
5. Furnishing and installation of new sodium hypochlorite generation system within the existing Hypo Building including:
  - a. Cast-in-place concrete equipment pad.
  - b. Sodium hypochlorite generator, transformer/rectifier, and control panel.
  - c. Water softener system.
  - d. Hydrogen gas dilution blower.
  - e. Associated PVC piping for hypochlorite, water, and brine distribution.
  - f. Associated electrical panels, sensors, and other SCADA implements.
6. Installation of new water feed line to the Hypo Building including tap on existing water main, isolation valve, and extension of water line into the building.
7. Electrical and instrumentation improvements associated with the brine tanks and hypochlorite generation system.
8. Related appurtenances and accessories for a complete and functioning system.

1.4 STATUS OF PERMITS AND EASEMENTS

- A. Permits for land disturbance are expected to be obtained before the 60-day period expires after the bid opening.
- B. There are no easements required for the proposed work.

\*\* END OF SECTION \*\*

SECTION 01020  
ALLOWANCES

1 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall include in his proposal the allowance amount(s) listed below.
- B. The allowance(s) shall cover work, manufactured equipment or services that will be provided either by the Contractor or by others who may be selected by the Owner. All work performed under allowance(s) will be eligible for payment only with the Owner's prior written approval, and under special terms described herein.
- C. Subcontract Allowances: Authorized subcontract work that is performed by subcontractors to the General Contractor and paid for under Allowances is considered to be subcontract work to the Contractor. Therefore, in accordance with the General Conditions of the Contract, actual payment to the Contractor will be actual cost of the subcontractor's charges plus a fee equal to five percent (5%) of subcontractor's charges.
- D. Cash Allowances for Purchases and Purchased Services: Where Contractor purchases equipment or materials that are authorized to be paid from Allowances and installed or incorporated into the project, the Contractor's costs for unloading, handling, installation, overhead, profit, taxes, and other expenses are to be included in Contractor's Bid Price. This same provision will apply to Purchased Services by Owner from parties who are not a subcontractor to the Contractor.
- E. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. The Contractor's handling costs on the site, labor, installation costs, overhead, profit, taxes, and other expenses contemplated for the original allowance shall be included in the Contract Sum and not in the allowance. The Contractor shall cause work covered by these allowances to be performed for such amounts and by such persons as the Owner/Engineer may direct, but he will not be required to employ persons against whom he makes a reasonable objection. If the cost, when determined, is more than or less than the allowance, the Contract Sum shall be adjusted accordingly by Change Order.

2 SCHEDULE OF ALLOWANCES

2.1 MAJOR EQUIPMENT ALLOWANCES

- A. The Contractor's Total Base Bid Price shall include an allowance of \$510,000.00 to cover the purchase price of the Sodium Hypochlorite Generation System and Brine Storage Tanks as described in the Specifications. This cost does not include federal, state, or local taxes. Taxes, if applicable, and any other associated costs shall be included in the Contractor's Lump Sum Bid price (Bid Items 1 and 2). Contractor shall execute a purchase order with MicroChlor no later than December 1, 2021. Contractor shall be responsible for paying any additional costs incurred as a result of his failure to execute a purchase order by December 1, 2021.

\*\* END OF SECTION \*\*

SECTION 01055  
CONSTRUCTION STAKING

1 GENERAL

1.1 SCOPE OF WORK

- A. Contractor's surveying and engineering responsibilities during the construction phase shall include the following:
1. Field surveying and engineering services required to supplement Contract Documents during construction of the Project. The Contractor shall employ qualified personnel acceptable to the Engineer to provide construction staking and shall furnish documentation confirming that staking is being performed to the lines and grades shown in the Contract Documents. Construction staking will include all the surveying work required to lay out the work and control the location, elevation and position of the finished construction in accordance with the contract documents. Contractor's surveyor shall maintain a complete, accurate log of all control and survey work as it progresses and shall periodically furnish copies of same to Engineer as the work progresses. Surveyor shall be registered in the State of Georgia.
  2. Civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.
  3. The contractor shall locate and protect control points prior to starting site work and preserve all permanent reference points during construction. Contractor's surveyor shall replace any control points that are lost or destroyed during construction.
  4. As-built plans of all construction shall be maintained by the Contractor and delivered to the Engineer at the completion of construction in a form that is acceptable to the Owner.
- B. Owner's responsibilities during the construction phase shall include the following:
1. The Owner will furnish Contract Documents including plan drawings with sufficient detail and geometric references to allow the Contractor to accurately construct the work.

\*\* END OF SECTION \*\*

SECTION 01060  
CODES AND STANDARDS

1 GENERAL

1.1 DESCRIPTION

- A. Whenever reference is made to conforming to the standards of any technical society, organization, body, code or standard, it shall be construed to mean the latest standard, code, specification adopted and published at the time of opening of Bids. This shall include the furnishing of materials, testing of materials, fabrication and installation practices.
- B. The inclusion of an organization under one category does not preclude that organization's standards from applying to another category.
- C. In addition, all work shall comply with the applicable requirements of local codes, utilities and other authorities having jurisdiction.
- D. The standards which apply to this Project are not necessarily restricted to those organizations which are listed in Article 1.2.

1.2 STANDARD ORGANIZATIONS

A. Piping and Valves

- 1. ANSI American National Standards Institute
- 2. ASME American Society of Mechanical Engineers
- 3. AWWA American Water Works Association

B. Materials

- 1. AASHTO American Association of State Highway and Transportation Officials
- 2. ANSI American National Standards Institute
- 3. ASTM American Society for Testing and Materials

C. Steel and Concrete

- 1. ACI American Concrete Institute
- 2. AISC American Institute of Steel Construction, Inc.
- 3. AISI American Iron and Steel Institute
- 4. CRSI Concrete Reinforcing Steel Institute
- 5. NRMA National Ready-Mix Association
- 6. PCA Portland Cement Association
- 7. PCI Prestressed Concrete Institute
- 8. SSPC Structural Steel Painting Council

D. Welding

- 1. AWS American Welding Society
- 2. NACE National Association of Corrosion Engineers

E. Government and Technical Organizations

- 1. CFR Code of Federal Regulations
- 2. CSI Construction Specifications Institute
- 3. FS Federal Specifications
- 4. ISO International Organization for Standardization
- 5. OSHA Occupational Safety and Health Administration

- 6. SBC            Standard Building Code
- F. Roadways
  - 1. DOT            Department of Transportation
  - 2. SSRBC        Standard Specifications for Road and Bridge Construction, Georgia  
Department of Transportation

### 1.3 DEFINITIONS

#### A. As Directed, as Required, Etc.

- 1. Wherever in the Contract Documents, or on the Drawings, the words "as directed," "as ordered," "as requested," "as required," "as permitted," or similar words are used, it shall be understood that the direction, order, request, requirement, or permission of the Engineer is intended. Similarly, the words "approved," "acceptable," "suitable," "satisfactory" and similar words shall mean approved by, acceptable to, suitable to, or satisfactory to the Engineer.

#### B. Provide

- 1. Wherever in the Contract documents the word "provide" is used, it shall mean to furnish (or supply) and install.

### 2 PRODUCTS (NOT USED)

### 3 EXECUTION (NOT USED)

\*\* END OF SECTION \*\*

SECTION 01150  
MEASUREMENT AND PAYMENT

1 GENERAL

1.1 SCOPE

- A. The Bid Proposal lists each item of the Project for which payment will be made. No payment will be made for any items other than those listed in the Bid Proposal.
- B. Required items of work and incidentals necessary for the satisfactory completion of the work which are not specifically listed in the Bid Proposal, and which are not specified in this Section to be measured or to be included in one of the items listed in the Bid Proposal, shall be considered as incidental to the work. All costs thereof, including Contractor's overhead costs and profit, shall be considered as included in the lump sum or unit prices bid for the various Bid Proposal items. The Contractor shall prepare the Bid Proposal accordingly.
- C. Work includes furnishing all plant, labor, equipment, tools and materials, which are not furnished by the Owner, and performing all operations required to complete the work satisfactorily, in place, as specified and as indicated on the Drawings.

1.2 PAYMENT

- A. Payment of lump sum items shall be based upon progress of the Work. Estimates of percent complete, as approved by the Engineer, shall be the basis by which payments will be authorized.
- B. Measurement of an item of work will be by the unit indicated in the Bid Proposal.
- C. Payment will be made by extending unit prices multiplied by quantities provided and then summing the extended prices to reflect actual work.

1.3 HYPOCHLORITE GENERATION SYSTEM

- A. Hypochlorite generation system installation shall be paid for at the lump sum price in the bid proposal. Price shall include all work at the facility for furnishing, installing, and starting up the new hypochlorite generation system including but not limited to preparation of area within building, relocation of necessary existing cabinets conduit, and piping, pouring new concrete housekeeping pad, repainting flooring, installation of new hypochlorite generation system, installation of new water supply, brine supply and hypochlorite solution piping, connections to existing piping and tanks, installation of new water softening system, installation of all required electrical work, installation of all required instrumentation and control work, and all related appurtenances for a complete and functioning system similar to the existing hypochlorite generation system.

1.4 BRINE TANKS AND ACCESS PLATFORM

- A. Brine tank installation shall be paid for at the lump sum price in the bid proposal. Price shall include all work at the facility for furnishing, installing, and starting up the new brine tanks including but not limited to installation of the required erosion control measures, layout and staking for the new brine tank foundation pad, excavation and subgrade preparation for the new brine tank foundation pad, pouring new concrete foundation pad, setting of brine tanks, installation and connection of all water supply, brine solution, and salt fill piping and valves, installation of electrical and instrumentation system, installation of required heat tracing and insulation system, installation of new aluminum access platform, removal and disposal of existing brine tank, backfilling and compaction of excavation, finish grading, seeding and straw placement, disturbed area stabilization and all related appurtenance required for a complete and functioning system.

1.5 WATER LINE INSTALLATION

- A. Water supply line installation shall be paid for at the lump sum price in the bid proposal. Price shall include all work at the facility for furnishing, installing, testing, and placing new water line in service including but not limited to installation of required erosion control

measures, excavation and grading to maintain required cover over the water line, furnishing and installing the proposed water line, making tap on existing water main, furnishing and installing required saddles, isolation valves, and meter boxes, coring building wall for installation of piping into existing building, backfilling and compaction of excavation, finish grading, seeding and straw placement, disturbed area stabilization, connection of the water supply to the water softening system, and all related appurtenance for a complete and functioning system.

#### 1.6 MOBILIZATION

- A. The cost for Mobilization shall be included in the lump sum prices bid for the associated specific work items in the bid form. No separate payment will be made for mobilization.

#### 1.7 ALLOWANCE

- A. Payment will be made for allowance work in accordance with Section 01020 of these contract documents.

#### 1.8 ADDITIONAL WORK

- A. Refer to General Conditions/Supplementary Conditions Articles 10 and 11.
- B. Additional work, when ordered by the Engineer, shall be measured and paid for in accordance with the General Conditions/Supplementary Conditions, and implemented as described in the following paragraphs. Measurement of the quantities of additional work shall be made by the Engineer.
- C. Lump Sum Pricing
  - 1. Should any single occurrence of additional work be ordered by the Engineer, and the additional work can be clearly defined and quantified, the Contractor shall develop a proposed lump sum price for the additional work. The price shall be inclusive of all labor, equipment, tools and materials necessary to complete the additional work, in place. The aforementioned shall not relieve the Owner of its right to require the Contractor to provide additional work, nor shall it limit the number of times additional work can be ordered.
  - 2. Payment for such additional work will be in accordance with the procedures defined in paragraph 1.2 A. of this section. Such price and payment shall constitute full compensation to the Contractor for furnishing all labor, equipment, tools and materials not furnished by the Owner and for performing all operations required to provide to the Owner the additional work, complete in place, in accordance with direction provided by the Engineer.
- D. Cost of the Work (Time and Materials) Pricing
  - 1. Should any single occurrence of additional work be ordered by the Engineer, and the additional work cannot be defined and/or quantified, the Contractor shall prepare and submit a detailed list of rates for personnel, equipment, tools, materials, and the like, that would be involved with delivery of the additional work. The rates shall be unburdened. Overheads, taxes, insurance, profit, and the like, shall also be identified discretely and be applied appropriately to the respective rates and costs, as per Article 11.4 of the General Conditions. The aforementioned shall not relieve the Owner of its right to require the Contractor to provide additional work, nor shall it limit the number of times additional work can be ordered.
  - 2. Payment for the additional work will be made by collecting all approved charges and providing full documentation with the respective application for payment. All additional work conducted under this format shall be documented and agreed to on a daily basis. All labor hours shall be recorded and agreed to, all operating equipment hours shall be recorded and agreed to, and all material invoices shall be collected and verified. Both Contractor and Engineer shall endorse all daily charges in writing, providing a copy of all charges to both Contractor and Engineer for record purposes. The Contractor shall be responsible for maintaining all original records and documents for payment purposes. Failure to document any charge may result in that charge being rejected for



payment. Such price and payment shall constitute full compensation to the Contractor for furnishing all plant, labor, equipment, tools and materials not furnished by the Owner and for performing all operations required to provide to the Owner the additional work, complete in place, in accordance with direction provided by the Engineer.

E. Markups (Fee)

1. Markups applied to additional work shall be as prescribed in Article 11.6 of the General Conditions.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 APPLICATION FOR PAYMENT

- A. Refer to Article 30 of the General Conditions/Supplementary Conditions.

\*\* END OF SECTION \*\*

## SECTION 01300

### SUBMITTALS

#### 1 GENERAL

##### 1.1 DESCRIPTION

- A. The work under this Section includes submittals by CONTRACTOR of shop drawings, product data and samples required by the various sections of these Specifications to the ENGINEER.
- B. Definitions: Submittals are categorized as follows:
  - 1. Shop Drawings
    - a. Shop drawings shall include technical data, fabrication and erection/installation drawings, drawings, diagrams, procedure and methodology, performance curves, schedules, templates, patterns, test reports, calculations, instructions, measurements and similar information as applicable to the specific item for which the shop drawing is prepared.
    - b. Provide newly prepared information with graphic information at accurate scale (except as otherwise indicated) or appropriate number of prints hereof, with name or preparer (firm name) indicated. Show dimensions and note, which are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements. Do not allow shop drawing copies without appropriate final "Action" markings by the ENGINEER to be used in connection with the Work.
    - c. Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet and detail, specification section or schedule shown on the Drawings.
  - 2. Product Data
    - a. Product data includes standard printed information on materials, products and systems, not specially prepared for this Project, other than the designation of selections from among available choices printed therein.
    - b. Collect required data into one submittal for each unit of work or system and mark each copy to show which choices and options are applicable to the Project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked and special coordination requirements.

##### 1.2 MANUFACTURER'S LITERATURE

- A. Where content of submitted literature from manufacturers includes data not pertinent to this submittal, clearly indicate which portion of the contents is being submitted for the ENGINEER's review.
- B. Submit the number of copies which are required to be returned plus four copies which will be retained by the ENGINEER.
- C. Submit all samples in the quantity which is required to be returned plus one sample which will be retained by the ENGINEER.

##### 1.3 COLORS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, wherever a choice of color or pattern is available in a specified product, submit accurate color charts and pattern charts to the ENGINEER for review and selection.
- B. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited to the installation, completely describe the relative costs and capabilities of each.

## 1.4 GENERAL SUBMITTAL REQUIREMENTS

### A. Scheduling

1. Where appropriate in various required administrative submittals (listings of products, manufacturers, supplier and subcontractors, and in job progress schedule), show principal work-related submittal requirements and time schedules for coordination and integration of submittal activity with related work in each instance.

### B. Coordination of Submittal Times

1. Prepare and transmit each submittal to the Engineer sufficiently in advance of performing related work or other applicable activities, so the installation will not be delayed or improperly sequenced by processing times, including non-approval and re-submittal (if required). Coordinate with other submittals, testing, purchasing, delivery and similar sequenced activities. No extension of time will be authorized because of Contractor's failure to transmit submittals to the Engineer sufficiently in advance of the work.

### C. Sequencing Requirements

1. As applicable in each instance, do not proceed with a unit of work until submittal procedures have been sequenced with related units of work, in a manner which will ensure that the action will not need to be later modified or rescinded by reason of a subsequent submittal which should have been processed earlier or concurrently for coordination.

### D. Preparation of Submittals

1. Provide permanent marking on each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and provide a 3" x 5" space for the Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through the Contractor's office will be returned "without action."

### E. Transmittal Identification

1. Number transmittals in sequence for each Division of the Specifications. The number before the dash indicates the Section of the Specifications, and the number after the dash is the sequence number of the transmittal (15140-1 would be the first transmittal applicable to Section 15140 of the Specifications, 15140-2 would be the second transmittal for Section 15140, etc.)
2. Identify re-submittals with a letter of the alphabet following the original number, using "A" for the first re-submittal, "B" for the second re-submittal, etc. A re-submittal affecting transmittal 15140-1 would then be numbered 15140-1A. The number 15140-1 would then be entered in the space "Previous Transmittal Number," which is left blank except on re-submittals. Re-submittals shall include all previous submittal information. No partial submittals will be accepted.
3. All submittals shall be made electronically in searchable PDF format.

## 1.5 ROUTING OF SUBMITTALS

### A. Submittals and routine correspondence shall be routed as follows:

1. Supplier to Contractor (through representative if applicable) for preliminary check.
2. Contractor to Consulting Engineer for general review or comment.
3. Consulting Engineer to Contractor.
4. Contractor to Supplier.

## 1.6 ADDRESS FOR COMMUNICATIONS

- ### A. Rockdale Water Resources
- Attn: Mr. David Cervone, P.E.  
1329 Portman Drive, Suite H  
Conyers, GA 30012  
(770) 278-7432

## 1.7 SUBMITTAL COPIES REQUIRED

### A. Samples

#### 1. Submittal

- a. At Contractor's option, provide preliminary submittal of a single set of samples for the Engineer's review and "action." Otherwise, initial submittal is final submittal unless returned with "action" which requires re-submittal. Submit two sets of samples in final submittal; one set will be returned.

#### 2. Quality Control Set

- a. Maintain returned final set of samples at project site, in suitable condition and available for quality control comparisons by Engineer and by others.

## 1.8 REVIEW OF SUBMITTALS

### A. Review Time

1. Allow 15 working days from the date the submittal is received in the Engineer's office for the Engineer to review and respond to each submittal, except allow longer periods where processing must be delayed for coordination with subsequent submittals. The Engineer will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination.

### B. Engineer's Action

1. "No Exception Noted" - Indicates the drawings have been reviewed for conformance with the contract documents and no exceptions have been taken. Proceed with the work.
2. "Furnish as Corrected" - Indicates the drawings have been reviewed for conformance with the contract documents and work may proceed in accordance with all comments. Re-submittal will not be required.
3. "Revise and Resubmit" - Indicates the drawings have been reviewed for conformance with the contract documents, and work may not proceed. After items to which exceptions have been taken are corrected, Contractor shall again submit copies for review.
4. "Rejected" - Indicates the drawings have been reviewed for conformance with the contract documents and are too incomplete or in an unacceptable condition for review. A notation will be made on the shop drawings as to the exceptions taken. Drawings shall be revised and resubmitted for review before proceeding with the work.
5. "Submit Specific Item" - Indicates that one or more items in the submittal were missing or incomplete. Work may commence on any items to which no exceptions were taken; missing or incomplete items must be submitted as noted.

## 1.9 DAILY REPORTS

- A. The Contractor shall submit daily reports to the Engineer. Reports shall contain, but not be limited to, a list of all employees and subcontractors by trade that worked on the job that day, received equipment and materials, survey stake-out data, erosion control maintenance updates.

## 2 EXECUTION

### 2.1 CONTRACTOR'S COORDINATION OF SUBMITTALS

- A. Prior to submittal for the ENGINEER review, the CONTRACTOR shall use all means necessary to fully coordinate all material, including the following procedures:

1. Determine and verify all field dimensions and conditions, catalog numbers and similar data.
2. Coordinate as required with all trades and all public agencies involved.

3. Submit a written statement of review and compliance with the requirements of all applicable technical Specifications as well as the requirements of this Section.
  4. Clearly indicate in a letter or memorandum on the manufacturer's or fabricator's letterhead, all deviations from the Contract Documents.
- B. Each and every copy of the submittal data shall bear the CONTRACTOR's stamp showing that it has been so checked. Shop drawings submitted to the ENGINEER without the CONTRACTOR's stamp will be returned to the CONTRACTOR for conformance with this requirement.
- C. The OWNER may deduct from the Contract amount costs associated with having to review a particular shop drawing, product data, or sample more than two times in order to receive an acceptable disposition.
- D. Grouping of Submittals
1. Unless otherwise specifically permitted by the ENGINEER, make all submittals in groups containing all associated items.
  2. No review will be given to partial submittals of shop drawings for items which interconnect and/or are interdependent. It is the CONTRACTOR's responsibility to assemble the shop drawings for all such interconnecting and/or interdependent items, check them and then make one submittal to the ENGINEER along with CONTRACTOR's comments as to compliance, non-compliance or features requiring special attention.
- E. Transmittal of Submittals
1. All submittals shall be submitted using a transmittal form similar to one furnished by the ENGINEER.
- F. Shop Drawing Details
1. All details on shop drawings shall show clearly the relation of the various parts of the main members and lines of the structure. Where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted for review.
- G. Deviations
1. If a shop drawing shows any deviation(s) from the requirements of the Contract Documents, the CONTRACTOR shall make specific mention of the deviation(s) on the transmittal form and provide a written description of the deviation(s) on separate 8-1/2 X 11 paper attached to the transmittal form.
- H. Maintenance and Lubrication Schedules
1. Submittals for equipment specified under Divisions 11, 13, 14, 15, and 16 shall include maintenance and lubrication schedules for each piece of equipment.
  2. Schedule of Submittals: As detailed in the General Conditions. The schedule shall provide for submittal of items which relate to one another to be submitted concurrently.

## 2.2 CONTRACTOR CERTIFICATION

- A. Each shop drawing, sample, and product data submitted by the CONTRACTOR shall have affixed to it the following certification statement:
- B. Certification Statement: By this submittal, I hereby represent that all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data have been determined and verified, and each item has been checked and coordinated with other applicable shop drawings and all Contract requirements. Further, these determination, verification, check, and coordination activities have been conducted by qualified personnel under my supervision.

## 2.3 TIMING OF SUBMITTALS

- A. Make all submittals in advance of scheduled dates for installation to provide all required time for reviews, for securing necessary reviews, for possible revision and resubmittal, and for placing orders and securing delivery.

- B. In scheduling, allow 15 working days for the ENGINEER's review following the receipt of the submittal.

## 2.4 REVIEWED SUBMITTALS

### A. ENGINEER Review:

1. Allow a minimum of 14 days for the ENGINEER'S initial processing of each submittal requiring review and response, except allow longer periods for submittals needing coordination with subsequent submittals. The ENGINEER shall inform the CONTRACTOR promptly when it is determined that a submittal being processed must be held for coordination.
2. Acceptable submittals with no review comment shall be marked "No Exceptions Noted". A submittal with an "NEN" status shall not be resubmitted.
3. Acceptable submittals with a minor comment or comments offered merely to alert the CONTRACTOR to some issue or provide information will be marked "Furnish as Corrected". A submittal with an "FAC" status shall not be resubmitted.
4. Submittals requiring minor corrections will be marked "Make Corrections Noted". The CONTRACTOR may order, fabricate and ship the products, provided the indicated corrections are made. A submittal with an "MCN" status must be completely resubmitted for review and marked "NEN" or "FAC" prior to installation or use of the submitted product. No payment will be made for materials stored onsite or incorporated into the work until the resubmittal obtains an "NEN" or "FAC" status.
5. Submittals marked "Revise and Resubmit" must be resubmitted with revisions reflecting the ENGINEER'S comments. The CONTRACTOR shall not order, fabricate or ship items that correspond to an "R&R" submittal.
6. Submittals marked "Rejected" are not acceptable. Upon return of a submittal so marked, the CONTRACTOR shall repeat the initial review procedure utilizing acceptable products.

- B. No product shall be installed that does not have a corresponding submittal bearing a status of "No Exceptions Noted" or "Furnish as Corrected". Maintain at the job site a complete set of current submittals indicating the review status established by the ENGINEER.

- C. Substitutions: In the event the CONTRACTOR obtains the ENGINEER'S approval for the use of products other than those which are listed first in the Contract Documents, the CONTRACTOR shall, at the CONTRACTOR'S own expense and using methods approved by the ENGINEER, make any changes to structures, piping and electrical work that may be necessary to accommodate these products.

- D. Use of the "No Exceptions Noted" or "Furnish as Corrected" notation on shop drawings or other submittals is general and shall not relieve the CONTRACTOR of the responsibility of furnishing products of the proper dimension, size, quality, quantity, materials and all performance characteristics, to efficiently perform the requirements and intent of the Contract Documents. The ENGINEER'S review shall not relieve the CONTRACTOR of responsibility for errors of any kind on the submittals. The ENGINEER'S review shall not relieve the CONTRACTOR of responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Engineer, Designer or the Owner, or by any officer or employee thereof, and the CONTRACTOR shall have no claim under the Contract on account of the failure, or partial failure, of the method of work, material or equipment so reviewed. Review is intended only to assure conformance with the design concept of the Project and compliance with the information given in the Contract Documents. The CONTRACTOR is responsible for dimensions to be confirmed and correlated at the job site. The CONTRACTOR is also responsible for information that pertains solely to the fabrication processes or to the technique of construction and for the coordination of the work of all trades.

## 2.5 RESUBMISSION REQUIREMENTS

- A. Accept full responsibility for the completeness of each resubmittal. Verify that all corrected data and additional information previously requested by the ENGINEER are provided on the resubmittal. Clearly mark and alert the ENGINEER to the presence of changes within the

resubmittal that are other than those required by the ENGINEER'S comments on the previous submittal. Requirements specified in initial submittals shall also apply to resubmittals.

**\*\* END OF SECTION \*\***

SECTION 01500  
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1 GENERAL

1.1 SCOPE

- A. Temporary facilities required for this work include, but are not necessarily limited to:
  - 1. Temporary utilities required by CONTRACTOR such as water, telephone, and electricity.
  - 2. Sanitary facilities.
  - 3. Temporary enclosures and construction facilities.

1.2 GENERAL

- A. Sanitary facilities and potable water shall be made available by the CONTRACTOR on the Project site on the first day that any activities are conducted on site. The other facilities shall be provided as the schedule of the Project warrants.
- B. Maintenance: Use all means to maintain temporary facilities in proper and safe condition throughout progress of the Work. In the event of loss or damage, immediately make all repairs and replacements necessary, at no additional cost to the OWNER.
- C. Removal: Remove all such temporary facilities and controls as appropriate relative to the progress of the Work, and as the requirements of the Contract provide.

1.3 TEMPORARY UTILITIES

- A. General
  - 1. Provide and pay all costs for electricity and sanitary utilities required for the performance of the Work.
  - 2. If water service is available to the site at the time of construction, OWNER will provide tap and meter at the curb and CONTRACTOR will provide service line and pay for water at standard local rates.

1.4 CONTRACTOR'S USE OF PREMISES

- A. Lands furnished by OWNER upon which CONTRACTOR and their respective Subcontractors shall perform the Work are as shown in the Contract Drawings.
  - 1. CONTRACTOR shall coordinate use of premises with the OWNER. The CONTRACTOR shall be responsible for all site activities conducted under the terms of this contract and/or under their purview.

1.5 PERMITS

- A. Permits, Licenses, or Approvals: The CONTRACTOR will be responsible for acquiring any permits that are required for this project/purchase. OWNER will waive fees on all permits issued by OWNER.
- B. The OWNER will obtain permits required from agencies of the State of Georgia and the United States of America.

1.6 PROTECTION OF WORK AND PROPERTY

- A. Comply with applicable Federal, State, and Local health, safety and environmental laws pertinent to this Work, or referenced by the Contract provisions, while on OWNER's property.
- B. During the performance of the Work, CONTRACTOR is responsible for adapting his means, methods, techniques, sequences and procedures of construction to allow effective and timely prosecution of the Work. In order to accomplish this, it may be necessary for the CONTRACTOR to plan, design, and provide various temporary services, utilities, temporary piping and heating, access, and similar items which will be included within the Contract Price.



## 1.7 VEHICULAR TRAFFIC

- A. CONTRACTOR's vehicular traffic must comply with OWNER's requirements. CONTRACTOR will coordinate vehicular traffic in a manner that will maximize overall access to the site and avoid interference with other CONTRACTORS working at the site.

## 1.8 PROJECT SIGN

- A. Should the CONTRACTOR desire to post their business name for delivery purposes, the CONTRACTOR may place an appropriately sized sign near project access points.

# 2 EXECUTION

## 2.1 RESPONSIBILITIES

- A. CONTRACTOR shall provide temporary facilities and controls as specified throughout this Section for use by CONTRACTOR's personnel at the site, or sites of the Work, until the project is complete.
- B. CONTRACTOR is solely responsible for temporary facilities and controls removal and restoration of the affected area when the temporary facilities and controls are no longer needed or required by virtue of the Work being complete.
- C. CONTRACTOR shall include in his Bid the costs associated with the temporary facilities and controls that are to be provided.

## 2.2 STORAGE YARDS AND BUILDINGS

- A. Temporary Storage Yards: CONTRACTOR may construct temporary storage yards for staging and storage of its own products, equipment, and materials. Location is subject to ENGINEER's approval.
- B. Temporary Storage Trailers: Trailers may be utilized for temporary storage. Location is subject to ENGINEER's approval.

## 2.3 SITE ACCESS

- A. General access to the site will be from Gees Mill Rd.

## 2.4 SITE SECURITY

- A. The CONTRACTOR shall be responsible for security of their temporary facilities, equipment, tools, vehicles, materials, work-in-place, and any other property located on site for the duration of this Contract.
- B. The CONTRACTOR shall remove all temporary facilities, equipment, tools, vehicles, materials, and any other property remaining upon completion of the Work, and no later than close-out of the Contract.
- C. Coordination: Coordinate traffic routing with that of others working in the same or adjacent areas.

## 2.5 CLEANING DURING CONSTRUCTION

- A. The site shall be maintained in a neat, clean, and orderly manner to allow and ensure ready access, safe working and observation conditions, and a workmanlike appearance. Debris, waste materials, refuse, and rubbish shall be collected and properly disposed of daily.

**\*\* END OF SECTION \*\***

SECTION 01620  
STORAGE AND PROTECTION

1 GENERAL

1.1 SCOPE

- A. The work under this Section includes, but is not necessarily limited to, the furnishing of all labor, tools and materials to properly store and protect all materials, products, and the like, including spare parts, for the proper and complete performance of the Work.

1.2 STORAGE AND PROTECTION

A. Storage

1. Maintain ample way for all plant traffic at all times.
2. All property damaged as a result of storing of material shall be properly replaced at no additional cost to the OWNER.
3. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.
4. All materials shall meet the requirements of these Specifications at the time that they are used in the Work.
5. Store products, including spare parts, in accordance with manufacturer's instructions. Products must be specifically prepared and certified for long-term outdoor storage by the manufacturer.

- B. Protection: Use all means to protect the materials and products, including spare parts, of every section before, during and after installation and to protect the installed work and materials of all other trades.

- C. Replacements: In the event of damage, immediately make all repairs and replacements at no additional cost to the OWNER.

- D. Products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports.

- E. Building products and materials such as cement and grout shall be stored indoors in a dry location. Building products such as rough lumber and plywood may be stored outdoors under a properly secured waterproof covering. Reinforcing steel, anchor bolts, concrete inserts, wire ties, wall ties, sleeves, and the like, shall be stored off the ground (e.g., on pallets) in a prepared area.

\*\* END OF SECTION \*\*

SECTION 01625  
GENERAL EQUIPMENT AND REQUIREMENTS

1 GENERAL

1.1 DESCRIPTION

- A. These General Equipment Requirements apply, in general, to all equipment and piping. They supplement the detailed equipment Specifications, but in case of conflict, the detailed equipment Specifications shall govern.

1.2 UNIT RESPONSIBILITY

- A. A single manufacturer shall assume unit responsibility for all items so specified in each technical section. Unit responsibility shall require that all items be products of, or guaranteed by, the manufacturer. The manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance and certifications on the equipment as a unit.

1.3 INSTALLATION

- A. All equipment and materials shall be installed by skilled mechanics, in accordance with the approved shop drawings and the printed instructions of the manufacturer and as indicated and specified. Installation shall include furnishing any required lubricant and oil and grease in accordance with manufacturer's recommendations.

1.4 ADAPTATION AND LOCATION OF EQUIPMENT

- A. When proposing equipment which requires an arrangement differing from that indicated on the drawings or specified, the CONTRACTOR must prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing necessary changes and embodying special features of the equipment he proposes to furnish. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the OWNER. Equipment which requires alteration of a structure or structures will be considered only if the CONTRACTOR assumes all responsibility for making and coordinating all necessary alterations. Any and all such alterations shall be made at no additional cost to the OWNER.

1.5 PATENT ROYALTIES

- A. All royalties and fees for patents covering materials, articles, apparatus, devices, or equipment shall be included in the Bid by the CONTRACTOR.

1.6 WORKMANSHIP AND MATERIALS

- A. All equipment shall be designed, fabricated and assembled in accordance with the most modern engineering and shop practice. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall be new and shall not have been in service at any time prior to delivery, except as required by tests.
- B. Materials shall be suitable for service conditions. Iron castings shall be close grained, gray iron free from blowholes, flaws or excessive shrinkage and shall conform to ASTM A 48, Class 30 minimum. Plugging of defective castings shall not be permitted. Castings shall be annealed to remove internal stresses prior to machining and shall have the mark number and heat number cast on them.
- C. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads.
- D. All replaceable or expendable elements such as filters, screens, drive belts, fuses, lamps, etc., shall be easily accessible and replaceable without need of dismantling equipment or

pipng. All such items shall be of a standard type that is readily available from multiple suppliers.

- E. Threaded openings for drains or vents in pump volutes, compressor or fan scrolls, air receivers, and heat exchangers which are plugged during normal operation shall be provided with stainless steel plugs.
- F. Include detailed installation instructions and a parts list for all equipment delivered to the Project site.
- G. Isolate all dissimilar metals to the satisfaction of the Engineer.

#### 1.7 LUBRICATION AND LUBRICATION FITTINGS

- A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during start-up or shutdown and shall not waste lubricants.
- B. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity by the CONTRACTOR to fill all lubricant reservoirs and to replace all lubricants consumed during testing, start-up and initial operation, plus sufficient quantities of lubricants to lubricate all equipment for one year of normal service.
- C. Where special run-in oil or storage lubricants are used, they shall be flushed out and replaced with the required service lubricant by the Manufacturer's Technical Representative.
- D. Tag each piece of equipment with a cloth tag showing proper type lubricant, period between lubrications, date of lubrication and worker's initials. Have space for 10 lubrication notations.
- E. Fittings shall be of the bull-neck, check type for use with a portable high-pressure grease gun.
- F. Except for rotating shaft couplings, all lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings or guards. Fittings shall be accessible from safe, permanent platforms or walk areas. Extension fittings and tubing shall be provided on all grease fittings that are installed in an inaccessible location. The extension is to be located so that equipment can be lubricated from the operating level without the use of ladders, staging or shutting down the equipment. Connection from a remote fitting to the point of use shall be with minimum 3/16-inch Type 316 stainless steel tubing, securely mounted parallel to equipment lines and protected where exposed to damage.

#### 1.8 SAFETY GUARDS

- A. All belt or chain drives, fan blades, couplings and other moving or rotating parts shall be covered on all sides by an OSHA-approved all-metal safety guard. Safety guards shall be fabricated from 16 USS gauge or heavier galvanized or aluminum-clad sheet steel or 1/2-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water. All safety guards shall comply with OSHA general industry standards, Part 1910, Subpart O, Machinery and Machine Guarding. Provide tachometer access on shaft ends.

#### 1.9 EQUIPMENT FOUNDATIONS AND GROUTING

- A. The CONTRACTOR shall furnish all materials and construct suitable raised, reinforced concrete foundations for all equipment in accordance with approved shop drawings and manufacturer installation instructions, even though such foundations may not be indicated on the Drawings.

#### 1.10 ALIGNMENT OF MOTORS AND EQUIPMENT

- A. In every case where a drive motor is connected to a driven piece of equipment by a flexible coupling, the coupling halves shall be disconnected and the alignment between the motor

and the equipment checked and corrected. Machinery shall first be properly aligned and leveled by means of steel wedges and shims or jacking screws near anchor bolts. Anchor bolts shall be tightened against the shims on wedges or jacking screws and the equipment shall again be checked for level and alignment before placing grout. Wedges shall not be placed between machined surfaces.

- B. In general, checking and correcting the alignment shall follow the procedures set up in the Standards of the Hydraulic Institute, Instructions for Installation, Operation, and Maintenance of Centrifugal Pumps. Equipment shall be properly leveled and brought into angular and parallel alignment.
- C. Equipment shall be installed in such a way that no strain is transmitted to the equipment by piping systems or adjacent equipment.

#### 1.11 GROUTING

- A. Use a special epoxy, non-shrink, or sand-cement grout in the placement of all pump, motor and equipment baseplates or bedplates, column baseplates, other miscellaneous baseplates and other grouting applications as shown on the Drawings.

#### 1.12 ERECTION AND SETTING

- A. In the erection and setting of all fabricated equipment, exercise care to ensure that each item of equipment is adequately supported so as not to bend or distort under its own weight until adequate foundation support and anchorage are provided. Use lifting lugs, angles or clips provided on equipment, in erecting and setting the equipment. Conform to the requirements of OSHA Construction Standards, Part 1926, Subpart R, Steel Erection, Subpart H, Material Handling, Storage, Use, and Disposal, and Subpart N, Cranes, Derricks, Hoists, and Conveyors for the erection and setting of equipment and structural steel. Erection of structural steel shall conform to the latest requirements of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.
- B. During placement and prior to any grouting or connection of adjacent piping, the equipment shall be leveled and aligned true to level, plumb, alignment and grade with all parts bearing or fitting the structure or equipment accurately and securely. It shall not be permitted to cock out of alignment, nor shall the Contractor redrill, reshape or force fit any fabricated items.
- C. Take all measurements necessary to properly fit Contractor's work in the field, at Contractor's sole responsibility for these measurements and the proper working out of all details. The Contractor shall be responsible for the correct fitting of all work in the field and the accurate placement of all anchor bolts installed by Contractor.
- D. Bring all parts to be erected or assembled into close contact. Before assembly, thoroughly clean all surfaces to be in contact with each other. Drift pins may be used only for bringing members into position, never to enlarge or distort holes. Torching or burning of holes or cutting of fabricated items to correct misalignment or shop errors shall not be permitted. Enlargement of holes necessary to make field connections shall be done only with the Engineer's approval by reaming with twist drills and in a manner acceptable to Engineer.
- E. Furnish all equipment with suitable eyebolt lifting lugs or lifting angles to facilitate handling.

#### 1.13 HYDRAULIC SYSTEMS

- A. Securely restrain all pipes, tubes and hoses for hydraulic fluid against movement.
- B. Equip all hydraulic fluid reservoirs for hydraulic power packs with a low level shut-off mechanism which shall stop operation of the power pack when the level of fluid in the reservoir reaches a predetermined low level.
- C. Equip all hydraulic systems with an alarm to notify the operator of system malfunction.

\*\* END OF SECTION \*\*

SECTION 01700  
CONTRACT CLOSEOUT

1 GENERAL

1.1 DESCRIPTION

- A. Contract closeout is the process that recognizes Substantial Completion, the transition of operations to the OWNER, and Final Completion. As the Work nears Substantial Completion, sequences of activities and their responsibilities need to be identified, planned, scheduled, and effectively implemented to facilitate a smooth completion of the overall project.
- B. This section defines the process by which the transition from construction to plant operations will be affected. Terms, roles, responsibilities, and actions will be identified herein.

1.2 RELEASES FROM AGREEMENTS

- A. Furnish OWNER written releases from any and all subcontractors or suppliers, or the like, who performed Work or supplied labor, materials, and/or services pursuant.
- B. In the event CONTRACTOR is unable to secure written releases, inform the OWNER of the reasons.

1.3 FINAL INSPECTION

- A. OWNER or its representatives will examine the site and/or Work, and OWNER will direct CONTRACTOR to complete Work that may be necessary to satisfy terms of the agreement.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 SUBSTANTIAL COMPLETION

- A. Substantial Completion is defined in the General Conditions.
- B. The intended use for the project is to have the new hypochlorite generation system and brine tanks complete and in service creating hypochlorite solution in accordance with contract requirements. The system is to be fully functional in the designed control mode and properly operating for a period of not less than seven (7) days before the Work will be eligible for declaration as substantially complete.
- C. All required certificates of proper installation shall be properly completed and submitted to the ENGINEER prior to the Work being eligible for declaration as substantially complete.
- D. The balance of Work remaining and all unsatisfactory work items shall be identified, compiled, and submitted to the ENGINEER, along with a schedule of completion for all listed activities prior to the Work being eligible for declaration as substantially complete. The ENGINEER shall be afforded 5 working days to review the index and schedule and preparation of the punch list. Upon development of the punch list, the Work may be declared substantially complete.
- E. The CONTRACTOR shall perform all punch list tasks in a manner which will not disrupt operations of the facility.

3.2 PUNCHLIST

- A. Development of the punch list is the result of a survey of the CONTRACTOR's work by the ENGINEER and the OWNER performed prior to Substantial Completion. The objective of the survey is to identify the activities which are incomplete or work products that are

unacceptable/unsatisfactory. The survey itself will corroborate the index of activities submitted by the CONTRACTOR.

### 3.3 FINAL ACCEPTANCE

- A. Final Acceptance is as addressed in the General Conditions.
- B. Completion of all punch list tasks/requirements is required prior to the Work being eligible for declaration as finally accepted.
- C. All record documents must be submitted to and accepted by the ENGINEER prior to the Work being eligible for declaration as finally accepted.
- D. All releases must be submitted to and accepted by the ENGINEER prior to the Work being eligible for declaration as finally accepted.

**\*\* END OF SECTION \*\***

SECTION 01710  
CLEANING

1 GENERAL

1.1 SCOPE

- A. This Section covers the general cleaning which the CONTRACTOR shall be required to perform both during construction and before final acceptance of the Project unless otherwise shown on the Drawings or specified elsewhere in these Specifications.

1.2 QUALITY ASSURANCE

- A. Daily, and more often if necessary, conduct inspections verifying that requirements of cleanliness are being met.
- B. In addition to the standards described in this Section, comply with all pertinent requirements of governmental agencies having jurisdiction.

1.3 HAZARDOUS MATERIAL AND WASTE

- A. The CONTRACTOR shall handle hazardous waste and materials in accordance with applicable local, state, and federal regulations. Waste shall be disposed of in approved landfills as applicable.
- B. The CONTRACTOR shall prevent accumulation of wastes which create hazardous conditions.
- C. Burning or burying rubbish and waste materials on the site shall not be allowed.
- D. Disposal of hazardous wastes or materials into sanitary or storm sewers shall not be allowed.

1.4 DISPOSAL OF SURPLUS MATERIALS

- A. Unless otherwise shown on the Drawings, specified or directed, the CONTRACTOR shall legally dispose off the site all surplus materials and equipment from demolition and shall provide suitable off-site disposal site, or utilize a site designated by the OWNER.

2 PRODUCTS

2.1 CLEANING MATERIALS AND EQUIPMENT

- A. Use only cleaning materials, methods and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material or as approved by the ENGINEER.

3 EXECUTION

3.1 PROGRESS CLEANING

A. General

- 1. Do not allow the accumulation of scrap, debris, waste material and other items not required for construction of this Work.
- 2. At least each week, and more often if necessary, completely remove all scrap, debris and waste material from the job site.
- 3. Provide adequate storage for all items awaiting removal from the job site, observing all requirements for fire protection and protection of the environment.
- 4. At all times maintain the site in a neat and orderly condition which meets the approval of the ENGINEER.



### 3.2 FINAL CLEANING

- A. Definitions: Unless otherwise specifically specified, "clean" for the purpose of this Article shall be interpreted as the level of cleanliness generally provided by commercial building maintenance subcontractors using commercial quality building maintenance equipment and materials.
- B. Prior to completion of the Work, remove from the job site all tools, surplus materials, equipment, scrap, debris and waste. Conduct final progress cleaning as described in 3.01 above.
- C. Unless otherwise specifically directed by the ENGINEER, hose down all paved areas on the site and all public sidewalks directly adjacent to the site; rake clean other surfaces of the grounds. Completely remove all resultant debris.
- D. Restoration of Landscape Damage: Any landscape feature damaged by the CONTRACTOR shall be restored as nearly as possible to its original condition at the CONTRACTOR's expense.
- E. Timing: Schedule final cleaning as approved by the ENGINEER to enable the OWNER to accept the Project.

\*\* END OF SECTION \*\*

SECTION 01720  
RECORD DOCUMENTS

1 GENERAL

1.1 SCOPE

- A. The work under this Section includes, but is not necessarily limited to, the compiling, maintaining, recording and submitting of project record documents as herein specified.
- B. Record documents to be prepared and submitted by the CONTRACTOR include, but are not limited to:
  - 1. As-built drawings
  - 2. Change orders and other modifications to the Contract
  - 3. ENGINEER field orders or written instructions, including Requests for Information (RFI) and Clarification Memorandums
  - 4. Reviewed shop drawings, product data and samples
  - 5. Test records
- C. The CONTRACTOR shall maintain on the Project site throughout the Contract Time an up-to-date set of Record Drawings.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Storage
  - 1. Store documents and samples in the CONTRACTOR's field office, apart from documents used for construction.
  - 2. Provide files and racks for storage of documents.
  - 3. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with format of these Specifications.
- C. Maintenance
  - 1. Maintain documents in a clean, dry, legible condition and in good order.
  - 2. Do not use record documents for construction purposes.
  - 3. Maintain at the site for the Local Governing Authority one copy of all record documents.
- D. Make documents and samples available at all times for inspection by ENGINEER.
- E. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding of a certificate for payment.

1.3 QUALITY ASSURANCE

- A. Unless noted otherwise, Record Drawings shall provide dimensions, distances and coordinates to the nearest 0.1 foot.
- B. Unless noted otherwise, Record Drawings shall provide elevations to the nearest 0.01 foot for all pertinent items constructed by the CONTRACTOR.

1.4 SPECIFICATIONS

- A. Legibly mark each section to record changes made by Requests for information (RFI), field order, clarification memoranda, or by change order.

1.5 SUBMITTAL

- A. At contract closeout, deliver Record Documents to the ENGINEER.
- B. Accompany submittal with transmittal letter, in duplicate, containing:
  - 1. Date

2. Project title and number
3. CONTRACTOR's name and address
4. Title and number of each record document
5. Signature of CONTRACTOR or CONTRACTOR's authorized representative

## 2 PRODUCTS (NOT USED)

## 3 EXECUTION

### 3.1 AS-BUILT DRAWINGS

- A. The CONTRACTOR must maintain an up-to-date field record set of drawings by marking changes and other information directly on a set of contract drawings. The ENGINEER will periodically review the as-built drawings to confirm that the recorded information is current.
- B. Making Entries on As-Built Drawings (including Technical Specifications):
  1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
    - a. Color Coding:
      - 1) Green when showing information deleted from Documents.
      - 2) Red when showing information added to Documents.
      - 3) Blue and circled in blue to show notes.
  2. Date all entries.
  3. Clearly annotate who is making the entry.
  4. Call attention to entry by "cloud" drawn around area or areas affected.
  5. Legibly mark to record actual changes made during construction, including, but not limited to:
    - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
    - b. Horizontal and vertical locations of existing and new underground facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
    - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
    - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
    - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and ENGINEER's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
  6. Dimensions on Schematic Layouts: Show on as-built drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
    - a. Clearly identify the item by accurate note such as "cast iron drain, "galv. water," and the like.
    - b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
    - c. Make identification so descriptive that it may be related reliably to the Technical Specifications.

7. Technical Specifications: Legibly mark to record and reference actual changes made during construction, including, but not limited to:
  - a. Approved changes to material, equipment or construction procedures referencing the document (RFI, CO, Addendum, Shop Drawing Submittal, etc.) that authorized the change.
  - b. Note all changes to material and equipment design, performance and maintenance criteria.

\*\* END OF SECTION \*\*

SECTION 01740  
WARRANTIES AND BONDS

1 GENERAL

1.1 PROJECT MAINTENANCE AND WARRANTY

- A. Maintain and keep in good repair the Work covered by these Drawings and Specifications until acceptance by the OWNER.
- B. The CONTRACTOR shall warrant for a period of one year, or for the period as specified in the technical specifications of these Contract Documents, from the date of OWNER's written acceptance of the Work, or portions of the Work, as defined in the Contract Documents, that the completed Work is free from all defects due to faulty products or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects. The OWNER will give notice of observed defects with reasonable promptness. In the event that the CONTRACTOR should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the OWNER may do so and charge the CONTRACTOR the cost thereby incurred. The Performance Bond shall remain in full force and effect throughout the warranty period.
- C. The CONTRACTOR shall not be obligated to make replacements which become necessary because of ordinary wear and tear, or as a result of improper operation or maintenance, or as a result of improper work or damage by another CONTRACTOR or the OWNER, or to perform any work which is normally performed by a maintenance crew during operation.
- D. The CONTRACTOR shall, at CONTRACTOR's own expense, furnish all labor, materials, tools and equipment required and shall make such repairs and removals and shall perform such work or reconstruction as may be made necessary by any structural or functional defect or failure resulting from neglect, faulty workmanship or faulty materials, in any part of the Work performed by the CONTRACTOR. Such repair shall also include refilling of trenches, excavations or embankments which show settlement or erosion after backfilling or placement.

\*\* END OF SECTION \*\*

SECTION 02000  
GENERAL CONSTRUCTION REQUIREMENTS

1 GENERAL

1.1 WORK INCLUDED

- A. The work described in this section applies to the Project in general. The Contractor shall comply with these requirements in performing all construction activities under the Contract. Provide labor, material, tools and equipment to perform site preparation work as indicated and specified.

1.2 BARRICADES AND WARNING SIGNS

- A. The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient lighting, danger signals and signs, provide sufficient number of watchmen and take all necessary precautions for the protection of the work and the safety of the facility staff and public.

1.3 PROTECTION OF PAVEMENT

- A. When working along paved area, the Contractor shall use rubber-tired or other equipment which will not damage the paving and when pavement is damaged through negligence or carelessness on the part of the Contractor during construction, it shall be replaced at no expense to the OWNER. Mats shall be used to support tracked equipment while in use or while sitting on pavement. In no case shall a tracked vehicle be "walked" along a paved area from one section of work to another.

1.4 EXISTING UTILITIES AND STRUCTURES

- A. Information regarding underground utilities on the drawings is not guaranteed as to accuracy or completeness. Prior to beginning work the Contractor shall request a field location through the Utilities Protection Center (811 or 1-800-282-7411) and any utility owners thought to have facilities in the area. The Contractor shall promptly compare these field-marked locations with the project plans and then notify the engineer of any anticipated problems or need for contract changes. It is the Contractor's responsibility to excavate for the purpose of determining exact elevations or locations at utility crossings and other critical locations well in advance of the work under this contract.
- B. All existing pipes, drains, or other structures on, above, or below ground shall be carefully supported and protected from injury and if injured, they shall be restored in a satisfactory manner by and at the expense of the Contractor.

1.5 BACKFILL MATERIAL - GENERAL

- A. Backfill material shall consist of soil or soil-rock mixture, which is free from topsoil, organic matter, and other deleterious substances. Large boulders, thick rock or quartz layers, which are not broken down by compaction equipment, will not be suitable for use in the fill.
- B. Backfill material shall be subject to the approval of the Engineer.

1.6 SIDEWALK REPLACEMENT

- A. Sidewalk removed shall be replaced with sidewalks of the same width, similar finish and a minimum of 4" thickness. The Contractor shall remove only those sections of sidewalk that need to be removed to carry out the work. Adjoining sections of sidewalk shall be protected from damage during construction. Sidewalks to be removed shall be removed to the nearest expansion joint or sawed at the nearest control joint.

1.7 DUST CONTROL

- A. Contractor shall use all means necessary to control dust on and near the work and all off-site areas. As a minimum, Contractor shall moisten all surfaces as required to prevent excessive dust from escaping the work site and all off-site areas.

1.8 CLEAN-UP AND MAINTENANCE

- A. All surplus materials, tools, temporary structures, excess dirt, rubbish and debris shall be removed by the Contractor and the site of construction shall be left in a clean and neat condition, satisfactory to the Engineer.
- B. After the work is accepted as a whole, the Contractor shall maintain the surface of the unpaved streets, adjacent curbs, sidewalks, gutters, street paving, shrubbery, fences, sod, grass and other disturbed surfaces for a period of one hundred twenty days thereafter.
- C. All labor and material required for such maintenance and/or repairs shall be furnished at no cost to the Owner, and the work shall be done in a manner satisfactory to the Engineer.

\*\* END OF SECTION \*\*

SECTION 02125  
EROSION AND SEDIMENTATION CONTROL FOR INFRASTRUCTURE PROJECTS

PART 1 – GENERAL

1.01 SCOPE

- A. The work specified in this Section consists of providing and maintaining temporary and permanent erosion and sedimentation controls as shown on the Drawings and as needed to comply with the Georgia Erosion and Sedimentation Control Act of 1975. Contractor's obligations under this section shall include:
1. Contractor shall install and maintain Best Management Practices (BMPs) necessary for compliance with regulations.
  2. Contractor shall be liable for any violations or enforcement actions by regulatory authorities in connection erosion and sedimentation control.
- B. The erosion control measures shown on the contract drawings constitute only a conceptual plan with minimum requirements. Additional Best Management Practices (BMPs), coordinated with the Contractor's specific construction operations and scheduling for this project, may be needed to prevent the transport of sediment from the construction area. Temporary and permanent erosion and sedimentation controls include grassing and mulching of disturbed areas and structural barriers for control of erosion and sedimentation within acceptable limits as established by the Georgia Erosion and Sedimentation Control Act of 1975, as amended, the Federal Clean Water Act, as amended, the Georgia Water Quality Control Act, as amended, and applicable codes, ordinances, rules, regulations and laws of local and municipal authorities having jurisdiction.
1. "Minimum BMP Requirements" for this project include:
    - a. Installation of silt fence at those locations where runoff leaves the construction zone; that is, the downhill edge of construction limits.
    - b. Installation of Construction Exits at locations where construction equipment is expected to exit from the construction zone. Note that in general these minimum locations are shown on the contract.
    - c. Installation of other BMPs that are shown on the contract drawings or listed herein under "Minimum BMP Requirements" for this project.
  2. "Additional BMP Requirements" for this project include all other work, beyond the "Minimum BMP Requirements" listed above, that is required to comply with this section of the contract documents.
- C. This work also includes the subsequent removal of temporary erosion and sedimentation controls.

1.02 SUBMITTALS



- A. Submit product data in accordance with the requirements of Section 01340 of these Specifications.
- B. Submit three copies of the Erosion, Sedimentation and Pollution Control Plan (ESPCP) to the Engineer for the project records.

### 1.03 QUALITY ASSURANCE

- A. Perform all work under this Section in accordance with all pertinent rules and regulations including, but not necessarily limited to, those stated in these Specifications. Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.
- B. Provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with the Georgia Erosion and Sedimentation Control Act of 1975, as amended (OCGA §12-7-1, et. seq.), local ordinances, other permits, local enforcing agency guidelines and these Specifications.
- C. Basic Principles
  - 1. Coordinate the land disturbance activities to fit the topography, soil types and construction operations.
  - 2. Minimize the disturbed area and the duration of exposure to erosive elements.
  - 3. Provide temporary or permanent stabilization to disturbed areas immediately after rough grading is complete.
  - 4. Safely convey run-off from the site to a stable outlet to prevent flooding and damage to downstream facilities resulting from increased runoff from the site.
  - 5. Retain sediment on-site that was generated on-site.
  - 6. Minimize encroachment upon watercourses.
- D. Implementation
  - 1. The Contractor is solely responsible for the control of erosion within the Project site and the prevention of sedimentation from leaving the Project site or entering waterways.
  - 2. The Contractor shall install temporary and permanent erosion and sedimentation controls which will ensure that runoff from the disturbed area of the Project site shall pass through a filter system before exiting the Project site.
  - 3. The Contractor shall provide temporary and permanent erosion and sedimentation control measures to prevent silt and sediment from entering the waterways.
  - 4. The Contractor shall limit land disturbance activity to the minimum required to perform the work required by the project.
  - 5. The Contractor shall maintain erosion and sedimentation control measures within disturbed areas on the entire site until final stabilization has been achieved on areas disturbed by construction. Maintenance shall include mulching, re-seeding, clean-out of sediment

barriers and sediment ponds, replacement of washed-out or undermined rip rap and adding of erosion control material as necessary.

6. All erosion and sediment control measures shall be installed prior to initiation of construction activities or immediately after if location of control measures interferes with construction.
7. The Contractor shall designate one individual to be responsible for implementation and maintenance of erosion and sediment controls on a 24-hour, everyday basis and shall furnish the individual's name, address, and 24-hour telephone number to the Owner. This information shall be updated as necessary.

## PART 2 – PRODUCTS

### 2.01 GENERAL

Standard vegetative and structural BMP measures shall comply with the Manual for Erosion and Sediment Control in Georgia. Products not listed in the manual may be utilized on the project upon approval by the person who prepared the Erosion, Sedimentation and Pollution Control Plan (ESPCP) for the project.

### 2.02 SEDIMENT BARRIERS

#### A. STAKED HAYBALES - Sd1

1. Hay bale barriers are placed in a single row on natural ground where the most likely erodible areas are located to restrain sediment particles carried by sheet flow.

#### B. SILT FENCE - Sd1

1. Silt fences are temporary measures to retain suspended silt particles carried by sheet flow.
2. Silt fence consists of silt fabric, as specified in the Georgia Department of Transportation list #36, wood or steel posts, and wire or nail fasteners.
3. Type Sd-S silt fence is a woven 36-inch wide filter fabric with wire reinforcement. Sediment barriers being used as Type S for sensitive areas shall have a support spacing of no greater than 4 feet on center, with each driven into the ground 18 inches.

- C. Stone Check Dams: Stone shall conform to the requirements of Section 805.01 of the Georgia Department of Transportation Standard Specification, latest edition, for Stone Dumped Rip Rap except the stone shall be graded stone ranging from 2 to 10-inches in size.

### 2.03 CONSTRUCTION EXIT STONE

Aggregate size shall be in accordance with the National Stone Association Size R-2 (1.5 to 3.5-inch stone).

### 2.04 CONCRETE

Concrete shall have a compressive strength of not less than 3,000 psi and shall conform to the requirements for Class "B" concrete.

## 2.05 RIPRAP

Stone Rip Rap: Unless shown or specified otherwise, stone rip rap shall be Georgia DOT, Type 3.

## 2.06 FILTER FABRIC

- A. Filter fabric used for sediment control purposes shall be the non-woven type and shall conform to the Georgia Department of Transportation Standard Specifications, Section 881.06 for non-woven fabrics.
- B. Filter fabric shall be an approved product on the Georgia Department of Transportation Qualified Product List No. 28, latest edition.

## 2.07 VEGETATIVE PRACTICES

### A. GENERAL

- 1. Disturbed areas shall be stabilized as construction progresses. For water mains installed within easements, the construction corridor shall not exceed 1,000 linear feet without stabilization. All other projects shall not exceed 300 linear feet without stabilization

### B. DISTURBED AREA STABILIZATION (WITH MULCHING ONLY) - Ds1

- 1. This practice is applicable where disturbed areas, temporarily idle, have not been established to final grade and/or where permanent vegetative cover is delayed for a period not to exceed 6 months.
- 2. Mulch materials shall consist of dry straw or hay, wood chips, erosion control matting or netting, or polyethylene film. The mulch should be uniform, spread over the designated area from 2 to 4 inches thick.
- 3. Any and all disturbed areas that have not yet reached final grade shall be stabilized with mulch or temporary grassing within fourteen (14) calendar days of disturbance.

### C. DISTURBED AREA STABILIZATION (WITH TEMPORARY SEEDING) - Ds2

- 1. Temporary seeding is a measure consisting of seeding and mulching to reduce erosion. All disturbed areas shall be seeded when and where necessary to reduce erosion.
- 2. This practice is applicable where disturbed areas, temporarily idle, have not been established to final grade and/or where permanent vegetative cover is delayed for up to 6 months.
- 3. Temporary seeding consists of a grass or grass-legume mixture suitable to the area and season of the year.

### D. DISTURBED AREA STABILIZATION (WITH PERMANENT VEGETATION) - Ds3

- 1. See Section 02936 – Grassing

### E. DISTURBED AREA STABILIZATION (WITH SODDING) - Ds4

1. See Section 02936 – Grassing

#### F. EROSION CONTROL SLOPE STABILIZATION- Ss

1. This practice is a protective covering (blanket) or soil stabilization mat used to stabilize disturbed areas until permanent vegetation on steep slopes, channels, or shorelines can be established.
2. Concentrated flow areas, all slopes steeper than 2.5:1 and with a height of ten feet or greater, and cuts and fills within stream buffers, shall be stabilized with the appropriate erosion control matting or blankets.
3. All blanket and matting materials shall be on the Georgia Department of Transportation Qualified Products List (QPL #62 for Blankets, QPL #49 for Matting).

### PART 3 – EXECUTION

#### 3.01 GENERAL

- A. All erosion and sediment control devices and structures shall be inspected by the Contractor after each rainfall event and maintained, repaired or supplemented as necessary to satisfy the contract requirements. Sediment ponds and barriers shall be cleaned out after buildup of sediment on a schedule that will prevent overflow of silt over the top of the barrier.
- B. After adequate permanent stabilization has been provided and accepted by the Engineer, all temporary erosion and sediment control structures and devices shall be removed.
- C. Basic Guidelines for Best Management Practices:
  1. Coordinate the land disturbance activities to fit the topography, soil types and site conditions.
  2. Minimize the size of disturbed areas and the duration of exposure of non-vegetated areas. Refer to Section 02612, 3.02, for trench excavation.
  3. Provide temporary or permanent stabilization to disturbed areas immediately after rough grading is complete.
  4. Safely convey run-off from the site to a stable outlet to prevent flooding and damage to downstream facilities resulting from increased runoff from the site.
  5. Retain sediment on-site as near as possible to the location where sediment originated.
  6. Minimize encroachment upon watercourses and stream buffers.

#### 3.02 SEDIMENT CONTROL

##### A. Construction Exit

1. Construction exit(s) shall be placed as shown on the Drawings, on the ESPCP, and as directed by the Engineer. A construction exit shall be located at any point traffic will be leaving a disturbed area to a public right-of-way, street, alley, sidewalk or parking area.

2. Placement of Construction Exit Material: The ground surface upon which the construction exit material is to be placed shall be prepared to a smooth condition free from obstructions, depressions or debris. The filter fabric shall be placed to provide a minimum number of overlaps and a minimum width of one foot of overlap at each joint. The stone shall be placed with its top elevation conforming to the surrounding roadway elevations. The stone shall be dropped no more than three feet during construction, and shall be GA DOT Standard Specification 800, Designation #57.
3. Construction Exit Maintenance: The Contractor shall regularly maintain the exit with the top dressing of stone to prevent tracking or flow of soil onto public rights-of-way and paved surfaces as directed by the Engineer.
4. Construction Exit Removal: Construction exit(s) shall be removed and properly disposed of when the disturbed area has been properly stabilized, the tracking or flow of soil onto public rights-of-way or paved surfaces has ceased and as directed by the Engineer.

#### B. Sediment Barriers

1. Sediment barriers shall include, but are not necessarily limited to, any device that prevents sediment from leaving the disturbed area and shall be installed as shown on the Drawings and as directed by the Engineer.
2. Sediment barriers shall be maintained to ensure the depth of impounded sediment is no more than one-half of the original height of the barrier or as directed by the Engineer. Torn, damaged, destroyed or washed-out barriers shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by the Engineer.
3. Silt fences, hay bales and rock check dams shall not be used in any flowing stream, creek or river.
4. Rip rap shall be placed as shown on the Drawings and as directed by the Engineer. Filter fabric shall be placed under all rip rap unless shown or specified otherwise; except that, filter fabric shall not be placed under rip rap on stream or drainage ditch crossings.

#### C. Temporary Grassing

1. Temporary grassing shall be used on any area within the construction limits that is not scheduled for a permanent stand of grass or mulch cover.
2. In those locations where Temporary Grassing is utilized, the grassing operation shall follow promptly behind the clearing operation as soon as the work allows.

#### D. Mulch Stabilization

1. Straw mulch stabilization or wood chips shall be used on any area within the construction limits that is not scheduled for a permanent or temporary stand of grass. Straw mulch shall be applied uniformly by hand or mechanical means to a depth of 6" (approximately 2 1/2 tons of dry straw per acre). To prevent displacement by wind and water after application, the straw mulch shall be pressed into the soil with a tracked vehicle or disk harrow.

2. Wood chip mulch stabilization may be used in any area when directed by the Engineer except any area where a permanent stand of grass is to be installed. Wood chips shall be spread uniformly to a depth of at least 3 inches.

E. Erosion Control Blankets

1. Erosion control blankets of an approved type shall be placed on slopes steeper than 3 horizontal to 1 vertical, on the bottom of ditches and others areas where necessary to limit erosion and facilitate the establishment of grass.

END OF SECTION

SECTION 02667  
TESTING OF PRESSURE PIPELINES

1 GENERAL

1.1 SCOPE OF WORK

- A. Perform hydraulic leakage and pressure test at a pressure of 1.5 times the working pressure for all newly installed piping. Any leakage in the segment installed under this contract shall be repaired by CONTRACTOR.

2 PRODUCTS

2.1 WATER FOR TESTING

- A. The CONTRACTOR shall furnish all equipment, piping and required labor to transport water from an existing hydrant or designated tank on-site to the test location for use in testing. The OWNER will provide the water required for testing the Work from a fire hydrant as directed by the OWNER. Contractor shall provide a fire hydrant meter to measure water usage.

2.2 TEST EQUIPMENT

- A. The CONTRACTOR shall provide all labor and equipment, including required pumps with regulated bypass meters and gauges, for conducting tests.

3 EXECUTION

3.1 GENERAL

- A. The entire length of all pressurized pipelines shall be field tested for tightness by a test as described hereinafter.
- B. The CONTRACTOR shall furnish all labor and equipment, including required pumps with regulated bypass meters and gauges, for conducting pipeline tests.
- C. The CONTRACTOR shall furnish all equipment, piping and required labor to transport water from its source to the test location for use in testing.
- D. Timing and sequence of testing shall be scheduled by the CONTRACTOR, subject to the approval of the ENGINEER. The CONTRACTOR shall provide the ENGINEER with a minimum of 24 hours notice prior to the start of any test. All tests must be observed by the ENGINEER.
- E. The CONTRACTOR shall repair any leaks discovered during the initial filling of the pipeline and during the testing sequence. All known and visible leaks shall be repaired whether or not the leakage rate is within allowable limits.

3.2 TEST PROCEDURES FOR PRESSURE PIPELINES

A. General:

- 1. All pipelines shall be pressure tested in accordance with the specifications following for each type of service.
- 2. All meters, fixtures, devices or applications which are connected to the pipeline system and which might be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped during the test procedures. Items that are damaged during the testing procedure shall be repaired or replaced by the CONTRACTOR at no expense to the OWNER.
- 3. Where any section of a pipeline is provided with concrete reaction blocking, the pressure test shall not be made until at least five days have elapsed after installation of the blocking.

4. Clean and test lines before requesting final acceptance. Where any obstruction is met, clean the lines by means of rods, swabs, or other instruments. When requested by the ENGINEER, flush out lines and manholes before final inspection.
- B. Pressure Piping:
1. All sections of pipeline subject to internal pressure shall be pressure tested in accordance with AWWA C600. A section of line will be considered ready for testing after completion of all thrust restraint and backfilling, subject to curing of concrete blocking as specified herein.
  2. Test Preparation:
    - a. Flush pipeline section thoroughly at flow velocities greater than 2.5 feet per second, to remove debris from pipe and valve seats. Partially operate valves and hydrants to clean out seats. Provide correctly sized temporary outlets in number adequate to achieve flushing velocities.
    - b. Provide temporary blocking, bulkheads, flanges and plugs to assure all new pipe, valves and appurtenances will be pressure tested.
    - c. Applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Unless permanent air vents are in place, insert temporary corporation stops at highpoints to expel air as line is filled with water.
    - d. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure. Differential pressure at valves and hydrants shall equal the maximum possible but shall not exceed manufacturer's pressure rating. Provide temporary back pressure to meet the differential pressure restrictions.
    - e. Valves and hydrants shall not be operated in either the opening or closing direction at differential pressures above their rated pressure.
  3. The test pressure shall be applied to the lowest point in the test segment and shall be maintained for a minimum of two hours.
  4. The test pressure shall not vary by more than 5 psi for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gauge with graduation not less than 5 psi.
  5. Leakage: Leakage shall be defined as the quantity of water that must be pumped into the test section equal to the sum of the water, to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
  6. Test Results: No test section of steel or ductile-iron pipe shall be accepted if the leakage exceeds the limits determined under Section 4 of AWWA C600. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results. Allowable leakage in PVC pipe, if used on the project, shall be 11.65 gallons per inch of nominal diameter per mile over a 24-hour period.
  7. Completion: After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.
- C. Miscellaneous Pressure Piping:
1. Upon completion of each piping system or sub-system, blow the lines free of dirt and debris and test in the presence of the ENGINEER. Wherever possible, test before the trench is backfilled. Drain piping shall be tested prior to encasement in concrete. The minimum test duration shall be one hour. The pipeline shall fail the test if a measurable pressure drop is observed.

### 3.3 REPAIRS - PIPELINES



- A. If the leakage exceeds the specified allowable limits, the point or points of leakage shall be sought out and remedied by the CONTRACTOR at no additional cost to the OWNER. Repair methods must be approved by the ENGINEER.

#### 3.4 CLEANUP

- A. After completing each section of the pipeline, the CONTRACTOR shall remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line and leave the entire right-of-way in a clean, neat, and serviceable condition.

#### 3.5 FINAL ACCEPTANCE

- A. No pipeline installation or hydraulic structure shall be accepted until compliance with allowable leakage limits.
- B. The CONTRACTOR will certify that all required tests have been successfully completed before the work is accepted.

\*\* END OF SECTION \*\*

## SECTION 02936

### GRASSING

#### 1 GENERAL

##### 1.1 SCOPE

- A. This section covers preparation of subsoil, placing of topsoil, grassing construction, protection, maintenance, guarantee and replacement of grassing, and related items necessary for the establishment of a suitable stand of grass in areas disturbed by the construction.

##### 1.2 SUBMITTALS

- A. Certification of Grass Seed: Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.

##### 1.3 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

##### 1.4 MAINTENANCE

- A. Provide service and maintenance of seeded areas until final completion and closeout of the project.
- B. Maintenance includes re-fertilization, weeding, mowing, watering, clean up, repair of all washouts, and gullies.

##### 1.5 ACCEPTANCE

- A. Establish a uniform stand of the specified grass with scattered bare spots, none of which is larger than one square foot, allowed up to a maximum of 3% of any grassed area.
- B. It shall be the responsibility of the Contractor to repair any erosion damage to the grassed area until the date of final acceptance.

#### 2 PRODUCTS

##### 2.1 MATERIAL STANDARDS

- A. Use materials that meet the requirements of the following Georgia Department of Transportation Standard Specifications:
  - 1. Wood Fiber Mulch DOT Sec. 718.2
  - 2. Emulsified Asphalt DOT Sec. 822
  - 3. Agricultural Lime DOT Sec. 882.2.01
  - 4. Seed DOT Sec. 890.2.01
  - 5. Sod DOT Sec. 890.2.02
  - 6. Fertilizer DOT Sec. 891.2.01
  - 7. Plant Topsoil DOT Sec. 893.2.01
  - 8. Mulch DOT Sec. 893.2.02
  - 9. Inoculants DOT Sec. 893.2.04
  - 10. Tackifiers DOT QPL 33

## 2.2 SEED MIXTURE

- A. The seed mixture will be selected based on the geographic zone, the time of planting and the desired species of permanent grassing. This project is located in DOT Zone 2. Whenever seeds are specified by their common names, use the strains indicated by their botanical names. Use inoculants as required based on the type of seed. See Section 700 of Georgia DOT Standard Specifications for required seed mixture and planting times to achieve the permanent types of grass for each area of the project listed below.
- B. Permanent grassing species to be Common Bermuda. A permanent stand of grass is required on all exposed slopes and areas adjacent to the approach road and turn-around. Areas below water level and areas around the edge of the river and reservoir do not require permanent grassing.
- C. Temporary Grassing may be required if planting is needed at a time when the desired permanent grassing cannot be seeded according to Section 700 of Georgia DOT Standard Specifications. Any temporary grassing must be approved by Engineer.
- D. When grassing right-of-way adjacent to existing lawns, use the same type of grass as is present on the lawn.

## 2.3 SOIL MATERIALS

- A. Conserve and stockpile the best topsoil from the site for use on grassed areas. If necessary, to achieve the specified stand of grass, Contractor shall haul in topsoil from offsite.

## 2.4 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry.
- B. Fertilizer: Use a balanced commercial fertilizer mixed grade such as 10-10-10, 6-12-12, 5-10-15, or other analysis and apply at the rate per acre needed based on soil test results.
- C. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.
- D. Erosion Fabric: Where required to contain erosion, install a biodegradable matting
- E. Lime: Use agricultural lime.

## 2.5 TESTS

- A. Soil samples shall be taken and tested to determine grade and rate of application rates of fertilizer and lime.

# 3 EXECUTION

## 3.1 EQUIPMENT

- A. Use grassing equipment able to produce the required results.

## 3.2 PREPARATION OF SOIL

- A. Prepare the ground by plowing under any temporary grass areas and preparing the soil as follows:
  - 1. Slopes 3:1 or Flatter:
    - a. Plow shoulders and embankment slopes to between 4 in and 6 in deep. In cut areas, plow to no less than 6 in deep. After plowing, thoroughly disk the area until pulverized to the plowed depth.
  - 2. Slopes Steeper Than 3:1
    - a. Prepare the ground to develop an adequate seed bed using any of the following methods: Plow to whatever depth is practicable. Use a spiked chain. Walk with a clefted track dozer. Scarify.

- B. Remove boulders, stumps, large roots, large clods, and other objects that interfere with grassing or mowing.
- C. Spread topsoil stockpiled during grading evenly over cut and fill slopes after preparing the ground and just before seeding is scheduled.
  - 1. Slopes on the dam shall have topsoil to a minimum depth of 4 inches.
  - 2. If sufficient topsoil is available, it shall be spread over areas of the roadway that are to receive grass. Take care to notch out shoulders or leave below grade so that topsoil does not cause ponding against the edge of the travel surface.

### 3.3 FERTILIZER AND LIME

- A. Apply fertilizer and lime at the recommended rate per acre in accordance with soil test results. Mix thoroughly in the top several inches of soil using harrows, tillers or other suitable equipment.

### 3.4 SEEDING

#### A. Inoculate Seed.

- 1. Inoculate each kind of leguminous seed separately with the appropriate commercial culture according to the manufacturer's instructions for the culture. When hydroseeding, double the inoculation rate. Protect inoculated seed from the sun and plant it the same day it is inoculated.

#### B. Sowing

- 1. Weather permitting, sow seed within 24 hours after preparing the seed bed and applying the fertilizer and lime.
- 2. Sow seed uniformly at the rates specified in the GA DOT Seeding Table for the specified type of permanent stand of grass.
- 3. Use approved mechanical seed drills, rotary hand seeders, hydraulic equipment, or other equipment to uniformly apply the seed. Do not distribute by hand.
- 4. To distribute the seeds evenly sow seed types separately, except for similarly sized and weighted seeds.

#### C. Rolling

- 1. Roll seeded areas before applying mulch, except on steep slopes where rollers cannot operate satisfactorily. On slopes inaccessible to compaction equipment, cover the seeds by dragging spiked chains over them or by using other methods.
- 2. Do not sow during windy weather, when the prepared surface is crusted, or when the ground is frozen, wet, or otherwise non-tillable.

#### D. Hydroseeding

- 1. Hydroseeding may be used on any grassing area. Under this method, spread the seed, fertilizer, and wood fiber mulch in the form of slurry. Seeds of all sizes may be mixed together. Inoculate the seeds at double the rate for seeds not being hydroseeded. Apply hydroseeding as follows:
  - a. Use wood fiber mulch as a metering agent and seed bed regardless of which mulching method is chosen.
  - b. Apply wood fiber mulch at approximately 1,500 lbs/acre.
  - c. Prepare the ground for hydroseeding as for conventional seeding.
  - d. Use specially designed equipment to mix and apply the slurry uniformly over the entire seeding area.
  - e. Agitate the slurry mixture during application.
  - f. Discharge slurry within one hour after being combined in the hydroseeder. Do not hydroseed when winds prevent an even application.

- g. Closely follow the equipment manufacturer's directions.
- h. Mulch the entire hydroseeded area.

### 3.5 MULCHING

- A. Evenly apply straw or hay mulch between 3/4 in and 1-1/2 in deep, according to the texture and moisture content of the mulch material.
- B. Mulch shall allow sunlight to penetrate and air to circulate as well as shade the ground, reduce erosion, and conserve soil moisture. If the type of mulch is not specified on the Plans or in the Proposal, use any of the following as specified.
  - 1. Mulch with Binder. Apply mulch with binder regardless of whether using sowing or hydroseeding methods for seeding. Apply manually or with special blower equipment designed for the purpose. When using a blower, thoroughly loosen baled material before feeding it into the machine so that it is uniformly coated with binder and broken up. After distributing the mulch initially, redistribute it to bare or inadequately covered areas in clumps dense enough to prevent new grass from emerging. Do not apply mulch on windy days. Apply enough binder to the mulch to hold it in place. Immediately replace mulch that blows away. When using a power blower to distribute the mulch, spray the binder onto the mulch as the mulch is ejected from the machine. If distributing the mulch by hand, immediately apply the binder uniformly over the mulched areas. Use one of the following binders: Emulsified asphalt, SS-1h or SS-1 (DOT Section 822); or use a tackifier listed in the Laboratory Qualified Products Manual. Follow manufacturer's recommended rates.
  - 2. Mixed-in-Place Mulch. Apply mixed-in-place mulch on flat areas or slopes 3:1 or less and treat as follows:
    - a. Immediately work the mulch into the soil with appropriate equipment to produce a loose soil and mulch mixture 3 in to 3.5 in (75 mm to 90 mm) deep.
    - b. After mixing mulch and soil and restoring areas to line and grade, seed as specified in this Section.
  - 3. Walked-in-Mulch
    - a. Apply walked-in-mulch on slopes ranging in steepness from 5:1 to 2:1 and treat as follows:
    - b. Immediately walk it into the soil with a cleated track dozer. Make dozer passes vertically up and down the slope.
    - c. Where walked-in-mulch is used, do not roll or cover the seeds.
- C. Cover seeded slopes where grade is 2:1 or greater with an approved erosion fabric installed according to manufacturer's recommendations.

### 3.6 MAINTENANCE

- A. After the grass has grown to a height of 2 inches and before final acceptance, one additional application of nitrogen at the rate of 50 lbs/acre must be applied.
- B. Apply nitrogen with mechanical hand spreaders or other approved spreaders capable of uniformly covering the grassed areas. Do not apply nitrogen on windy days or when the foliage is damp. Do not apply nitrogen between October 15 and March 15 except in Zone 4. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- C. Water to prevent grass and soil from drying out.
- D. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- E. Immediately reseed areas that show bare spots.
- F. Apply fertilizer at approximately 600 lbs/acre each spring after initial plant establishment until Final Acceptance.

- G. The Engineer may require replanting of an area that shows unsatisfactory growth for any reason at any time. Except as otherwise specified or permitted, prepare replanting areas according to the Specifications as if they were the initial planting areas. Grassed areas will be considered acceptable when a viable stand of grass covers at least 98% of the total area with no bare spots exceeding one square foot and the ground surface is fully stabilized against erosion.

**\*\* END OF SECTION \*\***

## SECTION 03200 CONCRETE REINFORCEMENT

### 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein.

#### 1.2 RELATED WORK

- A. Cast-in-place Concrete is included in Section 03300.

#### 1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
  - 1. Reinforcing steel. Placement drawings shall conform to the recommendations of ACI 315. All reinforcement in a concrete placement shall be included on a single placement drawing or cross referenced to the pertinent main placement drawing. The main drawing shall include the additional reinforcement (around openings, at corners, etc) shown on the standard detail sheets. Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified. For all cast-in-place concrete tanks, retaining walls, building stem walls, wall sections shall be included in the drawings.
  - 2. Bar bending details. The bars shall be referenced to the same identification marks shown on the placement drawings.
  - 3. Schedule of all placements to contain synthetic reinforcing fibers. The amount of fibers per cubic yard to be used for each of the placements shall be noted on the schedule. The name of the manufacturer of the fibers and the product data shall be included with the submittal.
- B. Submit Test Reports, in accordance with Section 01300, of each of the following items.
  - 1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.
  - 2. Welder's certification. The certification shall be in accordance with AWS D1.4 when welding of reinforcement required.

#### 1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
  - 3. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  - 4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
  - 5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
  - 6. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - 7. ASTM A616 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

8. ASTM A617 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
  9. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
  10. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
  11. ASTM A775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
  12. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
  13. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
- B. American Concrete Institute (ACI)
1. ACI 301 - Standard Specification for Structural Concrete
  2. ACI 315 - Details and Detailing of Concrete Reinforcement.
  3. ACI 318 - Building Code Requirements for Structural Concrete
  4. ACI SP-66 - ACI Detailing Manual
- C. Concrete Reinforcing Steel Institute (CRSI)
1. Manual of Standard Practice
- D. American Welding Society (AWS)
1. AWS D1.4 - Structural Welding Code Reinforcing Steel
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## 1.5 QUALITY ASSURANCE

- A. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

## 1.6 DELIVERY, HANDLING AND STORAGE

- A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.
- B. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.
- C. Reinforcing steel shall be stored off the ground and kept free from dirt, oil, or other injurious contaminants.

## 2 PRODUCTS

### 2.1 MATERIALS

- A. Materials shall be new, of domestic manufacture and shall comply with the following material specifications.
- B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.
- C. Concrete Reinforcing Bars required on the Drawings to be Welded: ASTM A706.
- D. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.
- E. Welded Deformed Steel Wire Fabric: ASTM A497.
- F. Welded Plain Bar Mats: ASTM A704 and ASTM A615 Grade 60 plain bars.



- G. Fabricated Deformed Steel Bar Mats: ASTM A184 and ASTM A615 Grade 60 deformed bars.
- H. The following alternate materials are allowed:
  - 1. ASTM A615 Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:
    - a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3000 psi.
    - b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
    - c. The carbon equivalency (CE) of bars shall be 0.55 or less.
- I. Reinforcing Steel Accessories
  - 1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.
  - 2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.
  - 3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.
  - 4. Steel Protected Bar Supports: #4 Steel Chairs with plastic or rubber tips.
- J. Tie Wire
  - 1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire or stranded wire.
- K. Mechanical reinforcing steel butt splices shall be positive connecting taper threaded type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to manufacturer's recommended value.
  - 1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125 percent of the ASTM specified minimum yield strength of the rebar.
  - 2. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.
- L. Fiber Reinforcement
  - 1. Synthetic reinforcing fiber for concrete shall be 100 percent polypropylene collated, fibrillated fibers as manufactured by Propex Concrete Systems Chattanooga, TN - Propex or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

## 2.2 FABRICATION

- A. Fabrication of reinforcement shall be in compliance with the CRSI Manual of Standard Practice.
- B. Bars shall be cold bent. Bars shall not be straightened or rebent.
- C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the ACI 318.
- D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded, shall have the applicable end(s) saw-cut. Such ends shall terminate in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

### 3 EXECUTION

#### 3.1 INSTALLATION

- A. Surface condition, bending, spacing and tolerances of placement of reinforcement shall comply with the CRSI Manual of Standard Practice. The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.
- B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:
  - 1. Concrete cast against and permanently exposed to earth: 3-in
  - 2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2-in (Including bottom cover of slabs over water or sewage)
  - 3. Concrete not exposed to soil, water, sewage, sludge and/or weather:
    - a. Slabs (top and bottom cover), walls, joists, shells and folded plate members – 3/4-in
    - b. Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1-1/2-in
- C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.
- E. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.
- F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.
- G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold-bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

#### 3.2 REINFORCEMENT AROUND OPENINGS

- A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

#### 3.3 SPLICING OF REINFORCEMENT

- A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters, but not less than 12-in. The lap splice length for column vertical bars shall be based on the bar size in the column above.
- B. Tension lap splices shall be provided at all laps in compliance with ACI 318. Splices in adjacent bars shall be staggered. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.

- C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.
- D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI-318 but not less than 12-in. The spliced fabrics shall be tied together with wire ties spaced not more than 24-in on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.
- E. Mechanical reinforcing steel splicers shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters. Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

#### 3.4 ACCESSORIES

- A. Determine, provide and install accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified herein.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

#### 3.5 INSPECTION

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

\*\* END OF SECTION \*\*

SECTION 03250  
CONCRETE JOINS AND JOINT ACCESSORIES

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete Reinforcement is included in Section 03200.
- B. Cast-In-Place Concrete is included in Section 03300.
- C. Concrete Finishes are included in Section 03350.
- D. Grout is included in Section 03600.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data. Submittals shall include at least the following:
  - 1. Standard Waterstops: Product data including catalogue cut, technical data, storage requirements, splicing methods and conformity to ASTM standards.
  - 2. Special Waterstops: Product data including catalogue cut, technical data, location of use, storage requirements, splicing methods, installation instructions and conformity to ASTM standards.
  - 3. Premolded joint fillers: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
  - 4. Bond breaker: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
  - 5. Expansion joint dowels: Product data on the complete assembly including dowels, coatings, lubricants, spacers, sleeves, expansion caps, installation requirements and conformity to ASTM standards.
  - 6. Compressible joint filler: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
  - 7. Bonding agents: Product data including catalogue cut, technical data, storage requirements, product life, application requirements and conformity to ASTM standards.
- B. Certifications
  - 1. Certification that all materials used within the joint system is compatible with each other.
  - 2. Certifications that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM A675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
  - 2. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

3. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
  4. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Types).
  5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- B. U.S. Army Corps of Engineers (CRD).
1. CRD C572 - Specification for Polyvinylchloride Waterstops.
- C. Federal Specifications
1. FS SS-S-210A - Sealing Compound for Expansion Joints.
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## 2 PRODUCTS

### 2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.
- C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than five years.

### 2.2 MATERIALS

#### A. Standard Waterstops

1. PVC Waterstops - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. The waterstop shall be Greenstreak Group, Inc. model No. 679 or approved equal for construction joints. The waterstop shall be Greenstreak Group Inc. model No.732 or approved equal for control joints and Greenstreak Group Inc. Model No. 738 for expansion joints. Provide grommets or pre-punched holes spaced at 12 inches on center along length of waterstop.
2. Factory Fabrications: Provide factory made waterstop fabrications for all changes of direction, transitions, and intersections, leaving only straight butt joints of sufficient length for splicing in the field.

#### B. Special Waterstops

1. Base Seal PVC Waterstop - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. Waterstops shall be style 925 for expansion joints, style 928 for control joints, and style 927 for construction joints by Greenstreak Plastic Products, St. Louis, MO or equal.
2. Preformed adhesive waterstops - The waterstop shall be a rope type preformed plastic waterstop meeting the requirements of Federal Specification SS-S-210A. The rope shall have a cross-section of approximately one square inch unless otherwise specified or shown on the Drawings. The waterstop shall be Synko-Flex waterstop as

manufactured by Synko-Flex Products of Houston, TX, Lockstop by Greenstreak Group Inc., or equal. Primer for the material shall be as recommended by the waterstop manufacturer.

C. Premolded Joint Filler

1. Premolded joint filler - Structures. Self-expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be 3/4-in unless shown otherwise on the Drawings.
2. Premolded joint filler - sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings. The joint filler shall be asphalt-impregnated fiber board conforming to ASTM D1751. Thickness shall be 3/4-in unless otherwise shown on the Drawings.

D. Bond Breaker

1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.
2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 77, by SCA Construction Supply Division, Superior Concrete Accessories or equal.

E. Expansion Joint Dowels

1. Dowels shall be smooth steel conforming to ASTM A675, Grade 70. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04-in on the diameter of the dowel and extends no more than 0.04-in from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end. Caps shall allow for at least 1-1/2-in of expansion.
2. Dowel Bar Sleeves: Provide Greenstreak two component Speed Dowel System, to accept 1" diameter x 12" long slip dowels. The Greenstreak Group, Inc. Speed Dowel System is comprised of a reusable base and a plastic sleeve. Both pieces shall be manufactured from polypropylene plastic.

F. Bonding Agent

1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, N.J.; Concreative Liquid (LPL) by Master Builders of Cleveland, OH or equal. Acrylic may be used if approved by the Engineer.

G. Compressible Joint Filler

1. The joint filler shall be a non-extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible Joint filler shall be Evasote 380 E.S.P, by E-Poxy Industries, Inc., Ravena, NY , Sikaflex 1a by Sika or equal.

### 3 EXECUTION

#### 3.1 INSTALLATION

A. Standard Waterstops

1. Install waterstops for all joints where indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided.

Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.

2. Horizontal waterstops in slabs shall be clamped in position by the bulkhead (unless previously set in concrete).
3. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.
4. Waterstops shall be terminated 3-in below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1-in deep, at point of termination.

#### B. Special Waterstops

1. Install special waterstops at joints where specifically noted on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.
2. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of connections or splices. Connections and splices shall conform to the manufacturer's recommendations and as specified herein.
3. Waterstops shall be terminated 3-in below the exposed top of walls.

#### C. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written approval.
2. Additional or relocated joints should be located where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.
3. All joints shall be perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings. When joints in beams are allowed, provide a shear key and inclined dowels as approved by the Engineer.
4. Provide sealant grooves for joint sealant where indicated on the Drawings.
5. At all construction joints and at concrete joints designated on the Drawings to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of approximately 1/4-in to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by water-blasting or sandblasting and prepare for bonding.
6. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.
7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

#### D. Expansion Joints

1. Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.
2. Position premolded joint filler material accurately. Secure the joint filler against displacement during concrete placement and compaction. Place joint filler over the

face of the joint, allowing for sealant grooves as detailed on the Drawings. Tape all joint filler splices to prevent intrusion of mortar. Seal expansion joints as shown on the Drawings.

3. Expansion joints shall be 3/4-in in width unless otherwise noted on the Drawings.
4. Where indicated on Drawings, install smooth dowels at right angles to expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement. Unless otherwise shown on the Drawings, apply oil or grease to one end of all dowels through expansion joints. Provide plastic expansion caps on the lubricated ends of expansion dowels.
5. Provide center bulb type waterstops in all wall and slab expansion joints in liquid containment structures and at other locations shown on the Drawings.

#### E. Control Joints

1. Provide sealant grooves, sealants and waterstops at control joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab control joints in water containment structures and at other locations shown on the Drawings.
2. Control joints may be sawed if specifically approved by the Engineer. If control joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking. No reinforcing shall be cut during saw cutting.
3. Extend every other bar of reinforcing steel through control joints or as indicated on the Drawings. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker prior to placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.

**\*\* END OF SECTION \*\***



SECTION 03300  
CAST-IN-PLACE CONCRETE

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete Reinforcement is included in Section 03200.
- B. Concrete Joints and Joint Accessories are included in Section 03250.
- C. Concrete Finishes are included in Section 03350.
- D. Grout is included in Section 03600.

1.3 SUBMITTALS

- A. The contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
  - 1. Sources of cement, pozzolan and aggregates.
  - 2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
  - 3. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
  - 4. Water-reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
  - 5. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.
  - 6. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type and manufacturer of cement. Provide either a. or b. below for each mix proposed.
    - a. Standard deviation data for each proposed concrete mix based on statistical records.
    - b. The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28-day cylinder strength test results for each mix. Provide results of 7 and 14 day tests if available.
  - 7. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.
  - 8. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.
- C. Samples
  - 1. Fine and coarse aggregates if requested by the Engineer.
- D. Test Reports

1. Fine aggregates - sieve analysis, physical properties, and deleterious substance.
2. Coarse aggregates - sieve analysis, physical properties, and deleterious substances.
3. Cements - chemical analysis and physical properties for each type.
4. Pozzolans - chemical analysis and physical properties.
5. Proposed concrete mixes - compressive strength, slump and air content.

E. Certifications

1. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certify admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
3. Certify curing compound is suitable for use in contact with potable water after 30 days (non-toxic and free of taste or odor).

#### 1.4 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete
7. ASTM C150 - Standard Specification for Portland Cement
8. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
13. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
14. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
15. ASTM C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.

B. American Concrete Institute (ACI)

1. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 318 - Building Code Requirements for Structural Concrete.
5. ACI 350 - Environmental Engineering Concrete Structures.

6. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## 1.5 QUALITY ASSURANCE

- A. Reinforced concrete shall comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes and standards. The most stringent requirement of the codes, standards and this Section shall apply when conflicts exist.
- B. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.
- C. Well in advance of placing concrete, discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops and curing. Propose methods of hot and cold weather concreting as required. Prior to the placement of any concrete containing a high-range water-reducing admixture (plasticizer), the Contractor, accompanied by the plasticizer manufacturer, shall discuss the properties and techniques of batching and placing plasticized concrete.
- D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.
- E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.
- F. Testing of the following materials shall be furnished by Contractor to verify conformity with this Specification Section and the stated ASTM Standards.
  1. Fine aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.
  2. Coarse aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.
  3. Cements for conformity with ASTM C150 - chemical analysis and physical properties.
  4. Pozzolans for conformity with ASTM C618 - chemical analysis and physical properties.
  5. Proposed concrete mix designs - compressive strength, slump and air content.
- G. Field testing and inspection services will be provided by the Owner. The cost of such work, except as specifically stated otherwise, shall be paid by the Owner. Testing of the following items shall be by the Owner to verify conformity with this Specification Section.
  1. Concrete placements - compressive strength (cylinders), compressive strength (cores), slump, and air content.
  2. Other materials or products that may come under question.
- H. All materials incorporated in the work shall conform to accepted samples.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Cement: Store in weather-tight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.
- B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3-ft in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.
- C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to uniform moisture content before using. Do not use frozen or partially frozen aggregates.
- D. Admixtures: Store in closed containers to avoid contamination, evaporation or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in

admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.

- E. Pozzolan: Store in weather-tight buildings, bins or silos to provide protection from dampness and contamination.
- F. Sheet Curing Materials: Store in weather-tight buildings or off the ground and under cover.
- G. Liquid Curing Compounds: Store in closed containers.

## 2 PRODUCTS

### 2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

### 2.2 CEMENT

- A. U.S. made portland cement complying with ASTM C150.
- B. Air entraining cements shall not be used.
- C. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work.

### 2.3 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: The following cement type(s) shall be used:
  - 1. All Classes - Type I/II or Type II
- C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.
- D. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 1 herein.
- E. Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.
- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures and shall be suitable for use in contact with potable water after 30 days of concrete curing.
  - 1. Air-Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
  - 2. Water-Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
  - 3. High-Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations. Where walls are 14" thick or less and the wall height exceeds 12 ft a mix including a plasticizer must be used.

4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.
- G. Pozzolan (Fly Ash): Pozzolan shall be Class C or Class F fly ash complying with ASTM C618 except the Loss on Ignition (LOI) shall be limited to 3 percent maximum.
- H. Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting all complying with ASTM C171.
- I. Liquid Curing Compound. Liquid membrane-forming curing compound shall comply with the requirements of ASTM C309, Type 1-D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. Curing compound shall be approved for use in contact with potable water after 30 days (non-toxic and free of taste or odor). Curing compound shall comply with Federal, State and local VOC limits.

## 2.4 MIXES

- A. Development of mix designs and testing shall be by an independent testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the Engineer, engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7 and 28 day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.
- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraph.
- E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
  1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.
- F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 5 to 8-in.
- G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE 1					
CONCRETE MIX REQUIREMENTS					
Class	Design Strength (1)	Cement (2)	Fine Aggregate (2)	Coarse Aggregate (3)	Cementitious Content (4)
A	2500	C150 Type II	C33	57	440 min.
B	3000	C150 Type II	C33	57	480 min.
C	4000	C150 Type II	C33	57	560 min.
D	5000	C150 Type II	C33	57	600 min.

Class	W/CM Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)	Slump Range Inches
A	0.62 max.	--	3.5 to 5	Yes	*	1-4
B	0.54 max.	--	3.5 to 5	Yes	*	1-3
C	0.44 max.	25% max	3.5 to 5	Yes	*	3-5
D	0.40 max.	--	3.5 to 5	Yes	*	3-5

NOTES:

- (1) Minimum compressive strength in psi at 28 days
  - (2) ASTM designation
  - (3) Size Number in ASTM C33
  - (4) Cementitious content in lbs/cu yd
  - (5) W/Cm is Water-Cementitious ratio by weight
  - (6) AE is percent air-entrainment
  - (7) WR is water-reducer admixture
  - (8) HRWR is high-range water-reducer admixture
- \* HRWR used at contractor's option except where walls are 14" thick or less and the wall height exceeds 12 ft a mix including a plasticizer must be used.

### 3 EXECUTION

#### 3.1 MEASURING MATERIALS

- A. Concrete shall be composed of portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may also be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use.
- C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batching tickets.

- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
  - 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
  - 2. Inject multiple admixtures separately during the batching sequence.

### 3.2 MIXING AND TRANSPORTING

- A. Batch plants shall have a current NRMCA Certification or equal.
- B. Concrete shall be ready-mixed concrete produced by equipment acceptable to the Engineer. No hand-mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- C. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- D. Keep the water tank valve on each transit truck locked at all times. Any addition of water above the appropriate W/Cm ratio must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- E. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.
- F. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal-lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- G. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.
- H. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
- I. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.
- J. Temperature and Mixing Time Control
  - 1. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40 degrees F.
  - 2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.

3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.
4. The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the values shown in Table 2.

TABLE 2	
MAXIMUM TIME TO DISCHARGE OF CONCRETE	
Air or Concrete Temperature (whichever is higher)	Maximum Time
80 to 90 Degree F (27 to 32 Degree C)	45 minutes
70 to 79 Degree F (21 to 26 Degree C)	60 minutes
40 to 69 Degree F (5 to 20 Degree C)	90 minutes

If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

### 3.3 CONCRETE APPEARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
  1. The gradation of aggregate.
  2. The proportion of fine and coarse aggregate.
  3. The percentage of entrained air, within the allowable limits.
- B. Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10-ft away, shall be pleasing in appearance, and at 20-ft shall show no visible defects.

### 3.4 PLACING AND COMPACTING

- A. Placing
  1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.
  2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.



3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.
6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.
7. Slabs
  - a. After suitable bulkheads, screeds and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
  - b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.
  - c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.
8. Formed Concrete
  - a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12 to 24-in lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 4-ft.
9. Underwater concreting shall be performed in conformity with the recommendations of ACI 304R. The tremie system shall be used to place underwater concrete. Tremie pipes shall be in the range of 8 to 12-in in diameter and be spaced at not more than 16-ft on centers nor more than 8-ft from an end form. Where concrete is being placed around a pipe, there shall be at least one tremie pipe on each side of each pipe. Where the tremie system is not practical, direct pumped concrete for underwater placement may be used subject to approval of the system including details by the Engineer.

#### B. Compacting

1. Consolidate concrete by vibration, puddling, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Puddling, spading, etc, shall be continuously performed along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.
2. All concrete shall be placed and compacted with mechanical vibrators. The number, type and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
3. A minimum frequency of 7000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30-in apart. At each insertion, vibrate sufficiently to

consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.

4. Concrete Slabs: Concrete for slabs less than 8-in thick shall be consolidated with vibrating screeds; slabs 8 to 12-in thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
  - a. Frequency returns to normal.
  - b. Surface appears liquefied, flattened and glistening.
  - c. Trapped air ceases to rise.
  - d. Coarse aggregate has blended into surface, but has not disappeared.

### 3.5 CURING AND PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

#### B. Curing Methods

1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
  - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
  - b. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
  - c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.
2. Specified applications of curing methods.
  - a. Slabs for Water Containment Structures: Water curing only.
  - b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.
  - c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.
  - d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
  - e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are

removed prior to 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete is made.

- f. Surfaces of Concrete Joints: Water cured or sheet material cured.
- C. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.
- D. Cold Weather Concreting:
1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.
  2. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified herein. Temperatures at the concrete placement shall be recorded at 12 hour intervals (minimum).
  3. Discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.
  4. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
    - a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (eg: 5 days at an average 70 degrees F = 350 degree-days).
    - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
  5. Salt, manure or other chemicals shall not be used for protection.
  6. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.
- E. Hot Weather Concreting
1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lbs/sqft/hr).
  2. Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.
    - a. Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
    - b. All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.
    - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.

3. Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

### 3.6 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing (whichever is the longer)

TABLE 3	
MINIMUM TIME TO FORM REMOVAL	
<u>Forms for</u>	<u>Degree Days</u>
Beams and slabs	500
Walls and vertical surfaces	100

- B. Shores shall not be removed until the concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

### 3.7 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.
- B. Sets of field control cylinder specimens will be taken by the Engineer (or inspector) during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls.
  1. A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if 28-day test results are low.
  2. When the average 28-day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7 day strengths (where proper relation between seven and 28 day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- C. Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations and furnish material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Owner. Curing boxes shall be acceptable to the Engineer.
- D. Slump tests will be made in the field immediately prior to placing the concrete. Such tests shall be made in accordance with ASTM C143. If the slump is greater the specified range, the concrete shall be rejected.
- E. Air Content: Test for air content shall be made on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance

with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173.

- F. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
- G. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the Owner.
- H. See Specification Section 03900 for Leak Testing.

### 3.8 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.
- B. When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60 percent of the required minimum 28-day strength, the concrete shall be rejected and shall be removed and replaced.

### 3.9 PATCHING AND REPAIRS

- A. It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will require no patching.
- B. Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as specified by the Engineer.
- C. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.
- D. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100. Promptly fill holes upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole

until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.

- E. When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

### 3.10 SCHEDULE

- A. The following (Table 4) are the general applications for the various concrete classes and design strengths:

TABLE 4		
CONCRETE SCHEDULE		
Class	Design Strength (psi)	Description
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavement
C	4,000	Walls, slabs on grade, suspended slab and beam systems, columns, grade beams and all other structural concrete
D	5,000	Prestressed concrete

\*\* END OF SECTION \*\*

## SECTION 03350 CONCRETE FINISHES

### 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified herein.

#### 1.2 RELATED WORK

- A. Cast-In-Place Concrete is included in Section 03300.
- B. Grout is included in Section 03600.

#### 1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
  - 1. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.

#### 1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.5 QUALITY ASSURANCE

- A. Finishes
  - 1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.
  - 2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for approval.
  - 3. Services of Manufacturer's Representative
    - a. Make available at no extra cost to the Owner, upon 72 hours notification, the services of a qualified field representative of the manufacturer of curing compound, sealer or hardener to instruct the user on the proper application of the product under prevailing job conditions.

### 2 PRODUCTS

#### 2.1 MATERIALS

- A. Chemical hardener shall be Lapidolith by Sonneborn; Hornolith by A.C. Horn; Penalith by W.R. Meadows or equal fluosilicate base material.
- B. Concrete sealer shall be "MasterKure CC 180 WB", by Master Builders Solutions, Shakopee, MN or equal.

### 3 EXECUTION

#### 3.1 FORMED SURFACES

- A. Forms shall not be removed before the requirements of Section 03300, have been satisfied.

- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or performing any other work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
- D. Rough-Form Finish
  - 1. Immediately after stripping forms and before concrete has changed color, carefully remove all fins and projections.
  - 2. Promptly fill holes left by tie cones and defects as specified in Section 03300.
- E. Rubbed Finish
  - 1. Immediately upon stripping forms and before concrete has changed color, carefully remove all fins. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.
  - 2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6-in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.
  - 3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)
  - 4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can be wiped off clean with the burlap.
  - 5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.
  - 6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.
  - 7. It is the intent of this finish to provide a surface that is uniform in appearance with no blemishes, imperfections, discolorations, etc.
- F. Abrasive Blast Finish
  - 1. Coordinate with Rubbed Finish application. Do not begin until Rubbed Finish operation is complete or before concrete has reached minimum 7-day strength. The Rubbed Finish application may be deleted by the Engineer if the unfinished concrete surface is of superior quality. Apply the abrasive blast finish only where indicated on Drawings.



2. Prepare a sample area of minimum 4-ft high by 16-ft wide Blast Finish as directed by Engineer on a portion of new wall construction which will not be exposed in the final work. Sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials and blasting techniques for selection by Engineer. Final accepted sample shall remain exposed until completion of all Blast Finish operations.
3. Blast finish operation shall meet all regulatory agency requirements. Blast Finish contractor shall be responsible for obtaining all required permits and/or licenses.
4. Perform abrasive blast finishing in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.
5. Use an abrasive grit of proper type and gradation as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:
  - a. Medium: Generally expose coarse aggregate - 1/4-in to 3/8-in reveal.
6. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure and blasting techniques required to match Architect's samples.
7. Upon completion of the Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit. Allow to air dry until curing of concrete is complete.
8. After the concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by manufacturer.

### 3.2 FLOORS AND SLABS

#### A. Floated Finish

##### 1. Machine Floating

- a. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding, a dry cement/sand shake in the proportion of two sacks of portland cement to 350 lbs of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 lbs /1,000 sq ft of floor. Do not sprinkle neat, dry cement on the surface.
- b. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight of a power float without its digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc type power compacting machine capable of providing a 200 lb compaction force distributed over a 24-in diameter disc.
- c. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.
- d. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

##### 2. Hand Floating

- a. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Screed the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green, but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-in indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.
3. Finishing Tolerances
    - a. Level floors and slabs to a tolerance of plus or minus 1/8-in when checked with a 10-ft straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that there are no low spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.
- B. Broom Finish
    1. Screed slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage, or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.
- C. Steel Trowel Finish
    1. Finish concrete as specified in Paragraph 3.04 and 3.05. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.
- D. Concrete Sealer
    1. Prepare and seal surfaces indicated on the room finish schedule to receive a sealer as follows:
      - a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule in Paragraph 3.05 below.
      - b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application-ready when it is damp but not wet and can no longer be marred by walking workmen.
      - c. Newly-Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.
      - d. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.
      - e. Methods: Apply sealer so as to form a continuous, uniform film by spray, soft-bristle pushbroom, long-nap roller or lambswool applicator. Ordinary garden-type sprayers, using neoprene hose, are recommended for best results.
      - f. Applications: For curing only, apply first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq ft per gallon. Apply second coat when all trades are completed and structure is ready for occupancy at the rate of 400 to 600 sq ft per gallon.
      - g. To meet guarantee and to seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full-strength. On aged concrete, when renovating, dustproofing and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

### 3.3 CONCRETE RECEIVING CHEMICAL HARDENER

- A. After 28 days, minimum, concrete cure, apply chemical hardener in three applications to a minimum total coverage of the undiluted chemical of 100 sq ft per gallon and in accordance with manufacturer's recommendations as reviewed.

### 3.4 APPROVAL OF FINISHES

- A. All concrete surfaces, when finished, will be inspected by the Engineer.
- B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked.
- C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300 unless otherwise directed by the Engineer.

### 3.5 SCHEDULE OF FINISHES

- A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.
- B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:
  - 1. Concrete to Receive Dampproofing: Rough-form finish. See Paragraph 3.01D above.
  - 2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough-form finish. See Paragraph 3.01D above.
  - 3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E above.
  - 4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E above.
  - 5. Vertical Concrete in Water Containment Areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level: Rough-form finish on remainder of submerged areas. See Paragraphs 3.01E and 3.01D above.
  - 6. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E above.
  - 7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.
  - 8. Interior or Exterior Horizontal Concrete not Requiring Floor Hardener or Sealer: Floated finish. See Paragraph 3.02A above.
  - 9. Concrete for Exterior Walks, Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.
  - 10. Concrete Slabs On Which Process Liquids Flow or In Contact with Sludge: Steel trowel finish. See Paragraph 3.02C above.
  - 11. Concrete to Receive Hardener: See Paragraph 3.03 above.
  - 12. Concrete to Receive Floor Sealer: See Paragraph 3.02D above.
  - 13. Concrete tank bottoms to be covered with grout: See Section 03600.

\*\* END OF SECTION \*\*

## SECTION 03600 GROUT

### 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

#### 1.2 RELATED WORK

- A. Concrete Reinforcement is included in Section 03200.
- B. Concrete Joints and Joint Accessories are included in Section 03350.
- C. Cast-in-Place Concrete is included in Section 03300.

#### 1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
  - 1. Commercially manufactured nonshrink cementitious grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.
  - 2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.
  - 3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.
  - 4. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated in Section 03200. This includes the mix design, constituent quantities per cubic yard and the water/cement ratio.
- B. Laboratory Test Reports
  - 1. Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.
- C. Certifications
  - 1. Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.
- D. Qualifications
  - 1. Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

#### 1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
  - 2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
  - 3. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. U.S. Army Corps of Engineers Standard (CRD)
  1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## 1.5 QUALITY ASSURANCE

- A. Qualifications
  1. Grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.
- B. Pre-installation Conference
  1. Well in advance of grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days prior to its scheduled date.
- C. Services of Manufacturer's Representative
  1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.
- D. Field Testing
  1. All field testing and inspection services required shall be provided by the Owner. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc, for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.
  2. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.
- B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.
- C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.
- D. Nonshrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

## 1.7 DEFINITIONS

- A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

## 2 PRODUCTS

### 2.1 GENERAL

- A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

- B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

## 2.2 MATERIALS

### A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
  - a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U. S. Grout Corp. or equal.
  - b. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp. or equal.

### B. Nonshrink Epoxy Grout

1. Nonshrink epoxy-based grout shall be a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of  $30 \times 10^{-6}$  when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout-Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co. or equal.

### C. Cement Grout

1. Cement grouts shall be a mixture of one part portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

### D. Concrete Grout

1. Concrete grout shall conform to the requirements of Section 03300 except as specified herein. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer and air entraining agent to produce a mix having an average strength of 2900 psi at 28 days, or 2500 psi nominal strength. Coarse aggregate size shall be 1/2-in maximum. Slump should not exceed 5-in and should be as low as practical yet still retain sufficient workability.
2. Synthetic reinforcing fibers as specified in Section 03200 shall be added to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

### E. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

## 3 EXECUTION

### 3.1 PREPARATION

- A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.
- B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to a minimum of ¼" amplitude or provide a raked finish in order to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
  - 1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil or other deleterious substances from metal embedments or bottom of baseplates prior to the installation of the grout.
- E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24-hour period, visible water shall be removed from the surface prior to grouting. The use of an adhesive bonding agent in lieu of surface saturation shall only be used when approved by the Engineer for each specific location of grout installation.
- F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.
- G. Construct grout forms or other leakproof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.
  - 1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- H. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.
- I. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

### 3.2 INSTALLATION – GENERAL

- A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and this Section.
- B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.
- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90 degrees F range.
- E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.
- F. Reflect all existing underlying expansion, control and construction joints through the grout.

### 3.3 INSTALLATION - CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.
- B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
- D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45-degree angle from the lower edge of bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.
- G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

### 3.4 INSTALLATION - NONSHRINK EPOXY GROUTS

- A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener and aggregate.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.
- C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- F. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

### 3.5 INSTALLATION - CONCRETE GROUT

- A. Screed underlying concrete to the grade shown on the Drawings. Prepare the surface according to 3.01B. Protect and keep the surface clean until placement of concrete grout.
- B. Remove the debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing of debris into tank drain lines will not be permitted.



- C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Saturation may be maintained by ponding, by the use of soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16 to 1/8-in thick cement paste. (A bonding grout composed of 1 part portland cement, 1.5 parts fine sand, an approved bonding admixture and water, mixed to achieve the consistency of thick paint, may be substituted for the cement slurry.)
- D. Place concrete grout to final grade using the scraper mechanism as a guide for surface elevation and to ensure high and low spots are eliminated. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms shall not be used as a finishing machine or screed.
- E. Provide grout control joints as indicated on the Drawings.
- F. Finish and cure the concrete grout as specified for cast-in-place concrete.

### 3.6 SCHEDULE

- A. The following list indicates where the particular types of grout are to be used:
- B. General purpose nonshrink cementitious grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-ft wide by 3-ft long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.
- C. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.
- D. Nonshrink epoxy grout: Use for the setting of anchor rods, anchor bolts and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.
- E. Cement grout: Cement grout may be used for grouting of incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting of primary structural steel members such as columns and girders.
- F. Concrete grout: Use for overlaying the base concrete under scraper mechanisms of clarifiers to allow more control in placing the surface grade.

\*\* END OF SECTION \*\*

## SECTION 05120 STRUCTURAL STEEL

### 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor and materials required and install structural steel including bearing plates, columns, beams and miscellaneous shapes and plates required to erect the structural framing as shown on the Drawings and as specified herein.
- B. Furnish only anchor bolts with templates to be installed under Division 3. Furnish and install nuts and washers for anchor bolts.

#### 1.2 RELATED WORK

- A. Grouting of baseplates is included in Section 03600.
- B. Miscellaneous metal is included in Section 05500.

#### 1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, erection drawings, detailed shop drawings, schedules and data for all structural steel. Approval will be for strength only and shall not relieve the Contractor of responsibility for proper fit of members, of connections not detailed on the Drawings, or for supplying all material required by the Contract Documents. Mark numbers painted on the shop assembled pieces of steel shall be the same mark numbers used on the detailed shop and erection drawings.
- B. Product data and installation instructions for Contractor proposed load indicator bolts or direct tension indicators.
- C. Certified mill test reports for the structural steel and the bolting materials.
- D. Certifications that welders are qualified, in accordance with AWS D1.1, on the shop and field welding procedures to be used.

#### 1.4 REFERENCE STANDARDS

- A. American Institute of Steel Construction (AISC)
  - 1. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges
  - 2. AISC 360 – Manual of Steel Construction – 14<sup>th</sup> Edition.
  - 3. AISC S335 - Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary.
  - 4. AISC M016 - Manual of Steel Construction Allowable Stress Design.
- B. American Society for Testing and Materials (ASTM)
  - 1. ASTM A36 - Standard Specification for Carbon Structural Steel
  - 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - 3. ASTM A123 - Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
  - 4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
  - 6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  - 7. ASTM A490 - Standard Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
  9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
  10. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
- C. American Welding Society (AWS)
    1. AWS A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
    2. AWS D1.1 - Structural Welding Code Steel.
  - D. Research Council on Structural Connections of the Engineering Foundation (RCSCEF)
    1. Specification for Structural Joints using ASTM A325 or ASTM A490 Bolts.
  - E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.5 QUALITY ASSURANCE

- A. Structural steel shall be in accordance with the AISC Standard for Structural Steel Buildings - Allowable Stress Design and Plastic Design and the Code of Standard Practice for Steel Buildings and Bridges, unless otherwise specified herein.
- B. Welding shall be in accordance with AWS D1.1 unless otherwise specified herein or in the AISC Standard.
- C. High strength bolt materials, accessories and installation shall be in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

#### 1.6 SYSTEM DESCRIPTION

- A. Design connections not detailed on the Drawings to support loads shown on the Drawings. Calculations for these connections shall be sealed by a registered professional engineer in the State of Georgia.
- B. Beam connections not detailed on the Drawings shall be bolted framed beam connections as shown in Table II of the AISC Manual of Steel Construction - Allowable Stress Design, Part 4.
- C. Bolted shear connections shall be bearing-type connections unless otherwise shown.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials promptly so as to cause no delay with other parts of the work.
- B. Store materials on skids and not on the ground. Pile and block materials so that they will not become bent or otherwise damaged.
- C. Handle materials with cranes or derricks as far as practicable. Do not dump steel off cars or trucks nor handle in any other manner likely to cause damage.

## 2 PRODUCTS

### 2.1 MATERIALS

- A. Rolled steel wide flange: ASTM A992.
- B. Plates, rods, bars, and other structural steel shapes other than wide flange shapes, unless otherwise noted: ASTM A36.
- C. Structural tube: ASTM A500, Grade B or ASTM A501.
- D. Structural pipe: ASTM A53, Type S, Grade B.
- E. Welding electrodes: AWS A5.1, E70XX.

- F. High strength steel bolts, nuts and washers: ASTM A325. Where galvanized material is to be connect; use ASTM A325, Type 1, mechanically galvanized to ASTM B695, Class 50, Type II.
- G. Anchor bolts: ASTM F1154, Grade 36. Provided standard headed bolts with heavy hex nuts and Grade A washers. Where galvanized anchor bolts are shown or specified, provide all components galvanized in accordance with ASTM F2329.
- H. Shop primer: As specified in Section 09900.
- I. Galvanizing: Zinc with 0.5 percent (minimum) nickel added.
- J. Galvanized surface primer: 95 percent zinc duck, organic vehicle primer.

## 2.2 FABRICATION

- A. Match-mark materials for field assembly. Ream unmatched holes in shop assembly of field connections. Reject and replace with new pieces any piece weakened by reaming to a point where the strength of the joint is impaired.
- B. Welding of parts shall be done only where shown on the Drawings or specified herein and by welders and welding operators qualified for the procedures used.

## 2.3 SURFACE PREPARATION AND SHOP COATINGS

- A. Prepare and shop prime paint non-galvanized members as specified in Section 09900. Omit paint within 3 inches of field welds. Do not prime paint faying surfaces of slip critical connections.

# 3 EXECUTION

## 3.1 INSTALLATION

- A. Furnish and install temporary bracing to provide stability during erection and to prevent distortion or damage to the framing due to wind, seismic, or erection forces. Remove temporary bracing when erection is complete.
- B. Use drift pins only to bring members into position and not to enlarge or distort holes.
- C. Make all steel to steel connections by high strength bolting except where field welding is shown or specified. Provide not less than two 3/4-in bolts per connection and use not less than 1/4-in thick clip angles.
- D. Tighten bolted connections designated as bearing-type connections to the snug tight condition. Tighten all other bolted connections to full pretension by turn-of-nut or calibrated wrench tightening.
- E. Field welding shall be done only where shown or specified and only by welders qualified for the procedures used. No welding shall be done when surfaces are wet, exposed to rain or wind, or when welders are exposed to inclement conditions that will hamper good workmanship.
- F. Each bolting crew [and welder] shall be assigned an identification mark. This mark shall be made at each completed connection with a paint stick.
- G. After erection, prime paint abrasions, field welds and unprimed surfaces, using shop primer except surfaces designated to be unpainted or surfaces in contact with concrete.
- H. After erection, prime paint abrasions, field welds, on galvanized surfaces with galvanized surface primer.

## 3.2 FIELD TESTING

- A. Allow the Engineer free access to the work. Notify the Engineer in writing 4 working days in advance of high strength bolting or field welding operations.
- B. High strength bolting will be inspected visually. All high strength bolts shall have the turned portion marked with reference to the steel being connected after the nut has been made snug and prior to final tightening. Retighten rejected bolts or remove and provide new

bolts. In cases of disputed bolt installations, the bolts in question shall be checked using a calibrated wrench certified by an independent testing laboratory approved by the Engineer. The certification shall be at the Contractor's expense.

- C. Field welding will be inspected visually by AWS certified welding inspectors provided by the Owner.
- D. The fact that steel work has been accepted at the shop and mill will not prevent its final rejection at the site, before or after erection, if it is found to be defective.
- E. Remove rejected steel work from the site within 10 working days after notification of rejection.

**\*\* END OF SECTION \*\***

SECTION 05500  
MISCELLANEOUS METALS

1 GENERAL

1.1 DESCRIPTION

Provide all labor, materials and equipment required to install, test and put in operation all miscellaneous metals as indicated on the drawings, as specified herein.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01300:

1. Manufacturer's literature describing standard items.
2. Shop Drawings showing materials, sizes, finishes, locations, attached hardware and fittings, and details for manufactured items and fabricated metalwork, including field erection details showing cuts, copes, connections, holes, thread fasteners and welds. Indicate welds, both shop and field, by symbols conforming to AWS standards. Indicate coatings or other protection against corrosion.
3. Setting diagrams, erection plans, templates and directions for installation of backing plates, anchors, and other similar items.

2 PRODUCTS

2.1 FABRICATION AND MANUFACTURE

A. GENERAL

1. Materials shall conform to type, size and shapes shown on drawings and conform to the following standard specifications:
  - a. Steel Shapes and Plates: ASTM A36.
  - b. Steel Pipe: ASTM A53.
  - c. Nuts, Bolts, Rivets, Washers, and Anchorage Devices: ASTM A325 and AISC Specification.
  - d. Steel Sheets: Cold-rolled or hot-rolled carbon steel, ASTM A366, or ASTM A569.
2. High-Strength, Low Alloy Corrosion-Resistant Steel:
  - a. Plates, Shapes, and Bars: ASTM A242 or A588.
  - b. Sheet and Strip ASTM A606 Type 4.
3. Stainless Steel:
  - a. General: Type (or Grade) 304L or 316L for welding, otherwise Type 304 or 316, as specified.
  - b. Shapes and Bars: ASTM A276.
  - c. Plate, Sheet, and Strip: ASTM A167.
  - d. Tubing: ASTM A269.
  - e. Pipe: ASTM A312, Schedule 40S.
4. Aluminum:

Plates, rolled or extruded shapes, sheets or castings conforming (unless otherwise permitted or indicated) to the following Aluminum Association alloy and temper designations:

  - a. Rolled structural sheets and plates: ASTM B209-6061-T6.

- b. Rolled Structural Shapes: ASTM B308-6061.
  - c. Extruded structural shapes: ASTM B221-6063-T5.
  - d. Gratings
    - (bearing bars): ASTM B211-6061-T6
    - (crimp bars): ASTM B211-6061-T5
  - e. Castings: ASTM B26-214.
  - f. Sheets: ASTM B209-Alclad 3003-H14 and 3003.
  - g. Bolts and nuts: Alloy 2024-T4.
  - h. Pipe railings: ASTM B241-6063-T6.
  - i. Handrail stanchions: ASTM B241-6063-T6.
5. Fabricate true to shape, size and tolerances as indicated and specified with straight lines, square corners or smooth bends; free from twists, kinks, warps, dents, and other imperfections. Straighten work bent by shearing or punching.
  6. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded. Construct connections and joints exposed to weather to exclude water.
  7. Provide sufficient quantity and size of anchors for the proper fastening of work.
  8. Fabricate details and connection assemblies in accordance with drawings and with projecting corners clipped and filler pieces welded flush.
  9. Weld shop connections, bolt or weld field connections, unless otherwise noted or specified.
  10. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
  11. Use connections of type and design required by forces to be resisted, and to provide secure fastening.
  12. Welding:
    - a. Grind exposed edges of welds to a 1/8-inch minimum radius. Grind burrs, jagged edges and surface defects smooth.
    - b. Prepare welds and adjacent areas such that there is (1) no undercutting or reverse ridges on weld bead, (2) no weld spatter on or adjacent to weld or any other area to be painted, and (3) no sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
  13. Bolting:
    - a. Draw up bolts or nuts tight, and deform threads where possible. Use bolts of lengths required so that bolts do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
    - b. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting equipment to supports to a tolerance of +/- 1/16-inch of exact dimensions indicated.
  14. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.
  15. Fabricated Products:
    - a. Pipe Sleeves in Concrete Construction: Weld standard weight, black steel pipe, with anchors to exterior to accommodate passage of conduits, pipes ducts and similar items.

- b. Provide stainless steel stud bolts with heavy aluminum washer and nuts for fastening aluminum pipe railing and handrails. Provide galvanized stud bolts, nuts and washers for fastening steel pipe railing and handrail.

#### B. ALUMINUM HANDRAIL

1. Handrail shall be the product of a company normally engaged in the manufacture of pipe railing. Railing shall be shop assembled in lengths not to exceed 24 feet for field erection.
2. Handrails shall be designed to withstand a 200# concentrated load applied in any direction to the top rail.
3. The manufacturer shall submit calculations to the Engineer for approval. Testing of base casting or base extrusions by an independent lab or manufacturer's lab (if manufacturer's lab meets the requirements of the Aluminum Association) will be an acceptable substitute for calculations. Calculations will be required for approval of all other design aspects.
4. Post spacing shall be a maximum of 6'-0". Posts and railings shall be a minimum of 1 1/2" schedule 40 aluminum pipe, alloy 6105-T5, ASTM B-429 or B-221. The handrail manufacturer shall show that their posts are of adequate strength to meet the loading requirements. If the manufacturer's posts are not of adequate strength, the manufacturer may reduce the post spacing or add reinforcing dowels or do both in order to meet the loading requirements.
5. The handrail shall be made of pipes joined together with component fittings. Samples of all components, bases, toeplate and pipe must be submitted for approval. Components that are glued or pop-riveted at the joints will not be acceptable. All components must be mechanically fastened with stainless steel hardware. Handrail and components shall be "TUFRAIL" as manufactured by Thompson Fabricating Company (Birmingham, AL.) or approved equal.
6. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations (OSHA 1910.23) The top surface of the top railing shall be smooth and shall not be interrupted by a projecting fitting.
7. The midrail at a corner return shall be able to withstand a 200# load without loosening. The manufacturer is to determine this dimension for their system and provide physical tests from a laboratory to confirm compliance.
8. Expansion bolts shall be spaced 10d apart and 5d edge distance for no reduction in pullout strength. A safety factor of 4 shall be used on expansion bolt pullout values published by the manufacturer. Expansion bolts shall be stainless steel type 303 wedge bolts and shall be furnished by the handrail manufacturer.
9. Toeplate shall conform to OSHA standards. Toeplate shall be a minimum of 4" high and shall be an extrusion that attaches to the posts with clamps which allow for expansion and contraction between posts. Toeplate shall be set 1/4" above the walking surface. Toeplates shall be provided on handrails as required by OSHA and/or as shown on the drawings. Toeplate shall be shipped loose, in stock lengths with pre-manufactured corners, for easy field installation.
10. Side mount handrail post stanchions, to concrete. Weld to extruded aluminum brackets. Secure brackets to concrete with four 1/2-inch diameter stainless steel expansion bolts.
11. Anchor handrail top and bottom rails to concrete wall with aluminum square flanges secured to concrete wall with four 3/8-inch diameter stainless steel expansion bolts.
12. Finish shall be Aluminum Association M10C22A41 (215-RI) clear anodized. The pipe shall be plastic wrapped. The plastic wrap shall be removed after erection.
13. Aluminum surfaces in contact with concrete, grout or dissimilar metals will be protected with a mylar isolator, bituminous paint or other approved material.
14. Provide removeable guard chains at openings in aluminum pipe railings. Fabricate from 1/4-inch wrought, non-welded aluminum chain having 12 links per foot. Secure chains to



aluminum eyes bolted or welded to pipe stanchions at one end of opening. Provide free ends of the chains with hooks formed from 1/4-inch diameter solid aluminum rod for attaching to similar eyes in the pipe stanchion or wall at the opposite end of the opening.

#### C. ALUMINUM GRATING

1. Where Aluminum grating or stair tread is shown on plans, it shall meet the requirements outlined below.
2. Aluminum grating shall be fabricated of I-shaped bars, alloy 6063-T6, with swaged cross bars spaced on 4" centers. Bearing bars shall be at least 1 1/4" in depth; spacing shall not exceed 13/16" on center. Top surface of bearing bars shall be striated to provide a nonslip surface.
3. Grating shall be designed to support a uniform load of 300 pounds per square foot with a maximum deflection of 1/4". The maximum fiber stress shall not exceed that which is allowed by the Aluminum Association.
4. Standard installation clearances and tolerances shall conform to the requirements of the current Metal Bar Grating Manual published by the National Association of Architectural Metal Manufacturers.
5. Install aluminum clamps or clips to anchor the grating securely to supports. A minimum of 4 fasteners per panel shall be provided, unless otherwise shown on the drawings.
6. Cutouts for circular obstructions are to be at least 2" larger in diameter than the obstruction. Cutouts for all piping 2" in diameter or less shall be made in the field. Band all ends of grating.
7. Aluminum shelf angles shall be anchored to the concrete using stainless steel (type 18-8) wedge anchors.
8. Paint all aluminum surfaces in contact with concrete or dissimilar metals with a shop coat of bituminous paint.
9. Submit loading tables from the manufacturer verifying span, load and deflection for the proposed system components.

#### D. ALUMINUM LADDERS

1. Rails shall be constructed of 3/8" X 2 1/2" flat aluminum bar and spaced 16" apart.
2. Wall mounted standoffs shall be 3/8" X 2 1/2" flat aluminum bar and welded to the rails at a maximum of 60" on center. The standoffs shall be a minimum of 7" and manufactured to fit flush with the wall.
3. 1-3/8" diameter slip resistant ribbed rungs shall be spaced 12" on center and shall be welded to the inside of each rail.
4. Units shall be as manufactured by Halliday Products, Series L1B; Thompson Fabricating Company, or approved equal.
5. An aluminum ladder safety post shall be provided on the wall side of the fixed ladder below the hatch cover and shall be as manufactured by Halliday Products, series L1E or approved equal. The device shall have a finish and shall be designed with telescoping tubular section that locks automatically when fully extended. To engage the ladder extension, grasp aluminum post above the top stainless steel channel clamp and pull straight up until the lower stainless steel pin is seated. The unit shall be completely assembled with fasteners for securing to the ladder rung in accordance with the manufacturer's instructions.

#### F. MISCELLANEOUS ITEMS

Provide items of miscellaneous metalwork not particularly specified, of the shape, size, material and detail indicated and suitable for the purpose intended.

### 3 EXECUTION

### 3.1 INSTALLATION

- A. Accurately set and properly secure in place. Where bolted connections are used, draw closely together and draw nuts tightly.
- B. Locate anchors and anchor bolts and build into connecting work. Insert expansion bolts into drilled holes.
- C. ALUMINUM PIPE RAILINGS
  - 1. Attach railing rails to face of concrete using aluminum flange and S.S. bolts as indicated.
  - 2. Attach railing posts to edge of concrete using welded aluminum bracket and S.S. bolts as indicated.
- D. ALUMINUM GRATINGS AND FRAMES

Anchor aluminum angles to existing concrete walls with S.S. expansion anchors.
- E. LADDERS
  - 1. Anchor uprights to wall with angles or bent plates, weld to uprights and use S.S. expansion bolts to wall. Ground smooth all welds.
  - 2. Secure interior ladders to floor slabs with floor flanges.
  - 3. Provide safety post system as indicated.
- F. CHAIN HOLDER

Fasten chain holder hook assembly to concrete with S.S. expansion bolts.

### 3.2 PROTECTION

- A. After erection, protect hatches and frames, ladders, and debris baskets from damage due to installation of other work or from lime, acid, cement, or other harmful compounds.
- B. Replace damaged hatches and frames, ladders, and debris baskets as determined by the Engineer with new items and at no additional expense to the Owner.
- C. Clean aluminum with mild soap and water, followed by clear water rinse, after erection.

END OF SECTION

## SECTION 07050

### PROCESS PIPING HEAT TRACING

#### 1 GENERAL

##### 1.1 SCOPE

- A. Work covered by this section includes furnishing all labor, materials, and equipment required to furnish and install pipe heat tracing and accessories as specified herein and/or shown on the Drawings.

##### 1.2 REFERENCES

###### A. Reference Standards

1. Factory Mutual
2. Institute of Electrical and Electronic Engineers, Inc. (IEEE): 515, Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.
3. National Electrical Manufacturers' Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
4. Underwriters Laboratories, Inc. (UL).

##### 1.3 SUBMITTALS

###### A. Action Submittals/Informational Submittals

1. Product Data
  - a. Manufacturer's descriptive literature.
  - b. Plastic Pipe: Output adjustment factors for heating tape for the services indicated.
2. Shop Drawings
  - a. Schematic drawings of system layout showing location of controls, thermostats, and length of tape for each system.
3. Delegated Design Submittals
  - a. Pipe heat loss calculations for each size pipe to be heat traced.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

###### A. Storage and Handling Requirements

1. Store heat tracing cable, controllers, and thermostats indoors in their original packing.

##### 1.5 WARRANTY

###### A. Manufacturer Warranty

1. Provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of the section titled Warranties and Bonds of these Specifications.

#### 2 PRODUCTS

##### 2.1 SYSTEM DESIGN REQUIREMENTS

###### A. Design Heating Load

1. Calculate the heating load based on a 50-degree F delta, 20 mph wind if pipes are located outdoors, and insulated as specified in Section 07051 with a 10 percent safety factor.
2. Base heat loss calculations on IEEE 515, Equation 1, Page 19.

## 2.2 ELECTRICAL HEATING TAPE

- A. Cable: Self-limiting, parallel circuit construction consisting of continuous inner core of variable resistance conductive heating material between two parallel copper bus wires. Provide tinned copper braid for PVC, FRP, and stainless steel pipe applications.
- B. UL Listing: Listed as self-limiting pipe tracing material for pipe freeze protection application in ordinary conditions. Where required provide UL listed and FM approved systems for Class I, Division 2 hazardous locations.
- C. Maximum Maintenance Temperature: 150 degrees F (65 degrees C).
- D. Maximum Intermittent Temperature: 185 degrees F (85 degrees C).
- E. Service Voltage: As indicated by branch circuits provided for heat tracing on the Drawings.
- F. Manufacturers
  1. Raychem; BTV-CR.
  2. Thermon; BSX.
  3. Nelson; CL1-J1 or L1-J1.
  4. Engineer approved equal.

## 2.3 CONNECTION SYSTEM

- A. Rating: NEMA 250, Type 4 and FM approved.
- B. Operating Monitor Light: Furnish with each circuit power connection kit to indicate when heat tracing is energized.
- C. Manufacturers
  1. Power Connection Kit:
    - a. Raychem; JBS-100.
    - b. Thermon; PCA-1 or DP-L.
    - c. Nelson; PLT-BC.
  2. Splice Kit:
    - a. Raychem; S-150.
    - b. Thermon; PCS-1-SR.
    - c. Nelson; PLT-BS.
  3. Tee Kit:
    - a. Raychem; T-100.
    - b. Thermon; DS-S.
    - c. Nelson; PLT-BY.
  4. End Seal Kit:
    - a. Raychem; E-150.
    - b. Thermon; DE-S.
    - c. Nelson; LT-ME.
  5. Lighted End Seal Kit:

- a. Raychem; E-100-L.
- b. Thermon; DLS.
- c. Nelson; LT-L.

## 2.4 SECURING TAPE

### A. Plastic Piping Systems

1. Type: Aluminum foil coated adhesive tape.
2. Manufacturers:
  - a. Raychem; AT-180.
  - b. Thermon; AL-20P.
  - c. Nelson; AT-50.

### B. Metallic Piping Systems

1. Type: Glass or polyester cloth pressure sensitive tape.
2. Manufacturers:
  - a. Raychem; GS54 or GT66.
  - b. Thermon; PF-1.
  - c. Nelson; GT-6 or GT-60

## 2.5 PIPE MOUNTED THERMOSTAT

- A. Type: Fixed, nonadjustable, set at 40 degrees F.
- B. Sensor: Fluid-filled with 3-foot capillary.
- C. Enclosure: Glass-filled nylon, NEMA 250, Type 4X weatherproof with gasketed lid.
- D. Switch: SP-ST, UL listed, rated 22 amps, 120 to 240V ac.
- E. Manufacturers
  1. Raychem; DigiTrace Model AMC-F5 or DigiTrace Model E507S-LS for hazardous areas.
  2. Thermon; E4X-1 or E7-25325 for hazardous areas.
  3. Engineer approved equal.

## 2.6 AMBIENT THERMOSTAT

- A. Type: Adjustable, setting (15 to 140 degrees F).
- B. Sensor: Fluid-filled probe.
- C. Enclosure: Epoxy-coated NEMA 250, Type 4X aluminum enclosure with exposed hardware of stainless steel.
- D. Switch: SP-ST, UL or FM listed, rated 22 amps, 125 to 250V ac.
- E. Manufacturers
  1. Raychem; DigiTrace Model AMC-1A or DigiTrace Model AMC-1H for hazardous areas.
  2. Thermon; B4X-15140 or B7-15140 for hazardous areas.
  3. Engineer approved equal.

### 3 EXECUTION

#### 3.1 INSTALLATION

##### A. General

1. Install heat tracing on all exterior above grade piping.
2. Install in accordance with manufacturer's instructions and recommended practices.
3. Provide insulation as specified in Section 07051 over all pipe heat tracing.
4. Ground metallic structures or materials used for support of heating cable or on which it is installed in accordance with applicable codes.
5. Have the system manufacturer provide wiring between power connection points of heat tracing cable branch lines.
6. Provide end of circuit pilot lights on heat tracing circuits for buried piping.

##### B. Electrical Heating Tape

1. Determine required length of electrical heating tape by considering length of circuit, number and type of fittings and fixtures, design heating load, and heating tape output.
2. Where design heating load exceeds heating tape capacity, install by spiraling.
3. De-rate heating tape capacity when installed on plastic piping.
4. Install in indicated services where:
  - a. The pipe size is 4 inches or less, unless otherwise noted, and
  - b. Exposed outside of a conditioned space, unless otherwise noted.
5. Install additional heating tape at bolted flanges, valves, pipe supports, and other fittings and fixtures as recommended by supplier, but not less than the following:

<b>Item</b>	<b>Heating Tape Length (min. feet)</b>
Bolted Flanges (per pair)	Two times pipe diameter
Valves	Four times valve length
Pipe hanger or support penetrating insulation	Three times pipe diameter

- C. Heat Tracing Circuits: Limit individual lengths of heat tracing circuits such that maximum single circuit capacity is 20 amps when starting the circuit at 40 degrees F. Provide multiple 20-amp circuits as required at individual heat tracing locations.

##### D. Thermostats

1. Install in accordance with manufacturer's instructions and as approved by the Engineer.
2. For each group of heat traced circuit, install one ambient thermostat.

#### 3.2 FIELD QUALITY CONTROL

- A. After installation and before applying insulation, test the system for grounds and short circuits using a 500 Vdc meter. Insulation resistance should exceed 10,000 megohms per 250 feet.

**\*\*END OF SECTION\*\***

## SECTION 07051

### PROCESS PIPING INSULATION

#### 1 GENERAL

##### 1.1 SCOPE

- A. Work covered by this section includes furnishing all labor, materials, and equipment required to furnish and install pipe insulation and accessories as specified herein and/or shown on the Drawings.

##### 1.2 REFERENCES

###### A. Reference Standards

1. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE): 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.
2. ASTM International (ASTM):
  - a. B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - b. C165 – Standard Test Method for Measuring Compressive Properties of Thermal Insulation.
  - c. C177 – Standard Test Method for Steady-State Heat Flux Measurement and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  - d. C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - e. C533 – Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - f. C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  - g. C547 – Standard Specification for Mineral Fiber Pipe Insulation.
  - h. C552 – Specification for Cellular Glass Thermal Insulation.
  - i. C585 – Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
  - j. C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
  - k. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
  - l. E96 – Standard Test Method for Water Vapor Transmission of Materials.
3. International Code Council (ICC) International Energy Conservation Code (IECC).
4. Manufacturers Standardization Society (MSS): SP-69 – Pipe Hangers and Supports.
5. National Fire Protection Association (NFPA): 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
6. Underwriters Laboratories Inc. (UL).

##### 1.3 SUBMITTALS

###### A. Action Submittals/Informational Submittals

1. Product Data
  - a. Manufacturer's descriptive literature including list of materials, thickness for each service scheduled, and locations.

- b. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.
  - c. Maintenance Information.
2. Manufacturer's Instructions
- a. Manufacturer's installation instructions.

#### 1.4 QUALITY ASSURANCE

##### A. Qualifications

###### 1. Manufacturers

- a. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.

###### 2. Materials

- a. Furnish materials under this Specification that are standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.

###### 3. Testing Agencies

- a. UL Listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

##### A. Delivery and Acceptance Requirements

- 1. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to Site shall have manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material.
- 2. Insulation packages and containers shall be marked "asbestos free".

##### B. Storage and Handling Requirements

- 1. Store insulation materials indoors in a clean, dry place. Store mastics and adhesives at a temperature of 50°F to 90°F.
- 2. Store insulation on end in its original packaging until used. Do not use damaged insulation and remove it from the site.

#### 1.6 WARRANTY

##### A. Manufacturer Warranty

- 1. Provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740.

## 2 PRODUCTS

### 2.1 GENERAL

- A. Provide insulation with cleanable, grease-resistant, non-flaking, and non-peeling exterior.
- B. Provide insulation conforming to referenced publications and specified temperature ranges and densities in pounds per cubic foot.
- C. Provide pre-molded, precut, or job-fabricated insulation of the same thickness and conductivity as used on adjacent piping for fittings, flanges, and valves.
- D. Fire Resistance



1. Provide noncombustible insulation, adhesives, vapor barrier materials and other accessories, except as specified herein.
2. Use no fugitive or corrosive treatments to impart flame resistance.
3. Flame proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
4. Materials exempt from fire resistance rating:
  - a. Nylon anchors
  - b. Treated wood inserts
5. Materials exempt from fire resistance rating when installed in outside locations, buried, or encased in concrete:
  - a. Polyurethane insulation
  - b. PVC casing
  - c. Fiberglass-reinforced plastic casing

## 2.2 PIPE INSULATION

### A. Type 1 - Elastomeric

1. Material: Flexible elastomeric pipe insulation, closed-cell structure in accordance with ASTM C534.
2. Temperature Rating: Minus 40 degrees F to 220 degrees F.
3. Nominal Density: 3 to 6 pcf.
4. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.25 Btu-in/hr-square foot degrees F at 75 degrees F per ASTM C177 or ASTM C518.
5. Minimum water vapor transmission of 0.08 perm-inch per ASTM E96, Procedure A.
6. Joints: Manufacturer's adhesive.
7. Flame Spread Rating: Less than 25 per ASTM E84.
8. Smoke Developed Index: Less than 50 per ASTM E84.
9. Manufacturers and Products:
  - a. Rubatex; Insul-Tube 180 or Insul-Sheet 1800
  - b. Armacell; AP Armaflex
  - c. Nomaco; K-Flex LS
  - d. Engineer approved equal.

### B. Type 2 - Fiberglass

1. Material: UL rated, preformed, sectional bonded fiberglass per ASTM C585 with factory applied, Kraft paper with aluminum foil vapor barrier jacket with pressure-sensitive, self-sealing lap.
2. Temperature Rating: Zero degrees F to 850 degrees F.
3. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.23 Btu-in/hr-square foot degrees F at 75 degrees F.
4. Jacketing per ASTM C1136 with minimum water vapor transmission for jacket of 0.02 perm-inch per ASTM E96. Furnish with no jacket if field finish system specified.
5. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
6. Flame Spread Rating: Less than 25 per ASTM E84.
7. Smoke Developed Index: Less than 50 per ASTM E84.

8. Manufacturers and Products:
  - a. Owens Corning Fiberglass; ASJ/SSL-II
  - b. John Manville; Micro-Lok with Jacket
  - c. Engineer approved equal.
- C. Type 3 - Foamglass
  1. Material: Cellular glass per ASTM C552.
  2. Temperature Rating: Minus 290 degrees F to 900 degrees F.
  3. Nominal Density: 7.5 pcf.
  4. Compressive Strength: 90 psi per ASTM C165.
  5. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.29 Btu-in/hr-square foot degrees F.
  6. Minimum water vapor transmission of 0.00 perm-inch per ASTM E96.
  7. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
  8. Flame Spread Rating: 0 per ASTM E84.
  9. Smoke Developed Index: 0 per ASTM E84.
  10. Follow manufacturer's recommendation, based upon temperature of piping to be insulated.
  11. Manufacturers and Products:
    - a. Pittsburgh Corning; Foamglass
    - b. Engineer approved equal.

## 2.3 FITTING INSULATION

- A. Type 1: Same as pipe.
- B. Type 2
  1. Wired in-place pre-molded insulation or mitered segments, or soft fiberglass insulation inserts covered with pre-molded 20-mil minimum thickness PVC fitting covers.
  2. Manufacturers
    - a. Manville Zeston
    - b. Speedline
    - c. Proto Corp.
    - d. Ceel-Co
    - e. Engineer approved equal
- C. Type 3: Same as pipe.

## 2.4 INSULATION AT PIPE HANGERS AND SUPPORTS

- A. Refer to Section 15094 – Pipe Supports and Hangers.
- B. Copper, Ductile Iron, and Nonmetallic Pipe: High density inserts, thickness equal to adjoining insulation, or Type 3 or other rigid insulation or manufactured pre-insulated pipe hangers and insulation shields per MSS SP-69, Table 5 at support locations. Extend inserts beyond shields.
- C. Steel Pipe: Insulation saddles or high-density inserts, thickness equal to adjoining insulation, or Type 3 or other rigid insulation or manufactured pre-insulated pipe hangers

and insulation shields per MSS SP-69, Table 5 at support locations. Extend inserts beyond shields.

## 2.5 INSULATION FINISH SYSTEMS

### A. Type F1 – PVC

1. Polyvinyl chloride (PVC) jacketing, minimum 20 mils indoors and 30 mils outdoors, white, for straight run piping and fitting locations, temperatures to 140 degrees F.
2. Flame Spread Rating: 25 per ASTM E84.
3. Smoke Developed Index: 50 per ASTM E84.
4. Manufacturers and Products
  - a. Knauf; Proto 1000
  - b. John Manville; Zeston 2000
  - c. Engineer approved equal.

### B. Type F2 – Paint

1. Type 1 Insulation
  - a. Acrylic latex paint, white, and suitable for outdoor use.
2. Type 2 Insulation: Per Specification Section 09 91 00 – Painting.

### C. Type F3 – Aluminum

1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100, or 3105 to ASTM B209 with H-14 temper, minimum 0.016-inch thickness, with smooth mill finish.
2. Vapor Barrier: Provide factory applied vapor barrier, consisting of 40-pound kraft paper with 1-mil thick low-density polyethylene film, heat and pressure bonded to inner surface of aluminum jacketing.
3. Fitting Covers: Material as for aluminum roll jacketing, pre-molded, one mechanical line couplings, and specialty fittings.
4. Manufacturers
  - a. RPR Products; Insul-Mate
  - b. Childers
  - c. Pabco
  - d. Engineer approved equal.

### D. Type F4 – Foamglass Jacketing

1. Type 3 Insulation – Buried and up to 1 Foot Above Grade: Jacket system to Pittsburgh Corning Pittwrap SS, 70-mil bituminous resin with woven glass fabric, aluminum foil layer, and plastic film coating, heat sealed at overlap.
2. Type 3 Insulation – Greater than 1 Foot Above Grade: Jacket system to Pittsburgh Corning Pittwrap CW30, 30-mil modified bituminous membrane with manual jacket seals.

## 3 EXECUTION

### 3.1 APPLICATION

#### A. General

1. Insulate valve bodies, flanges, and pipe couplings.

2. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
3. Do not insulate flexible pipe couplings and expansion joints.
4. Service and Insulation thickness:
  - a. Potable Water
    - 1) All pipe sizes: 1½ inches
  - b. Potable Hot Water
    - 1) ¾ inches and below: 1-inch
  - c. Brine or Hypochlorite Solution Piping
    - 1) All pipe sizes: 1½ inches.

### 3.2 INSTALLATION OF INSULATION

#### A. General

1. Install in accordance with manufacturer's instructions and as specified herein.
2. Install insulation after piping system has been pressure tested and leaks corrected.
3. Apply insulation over clean, dry surfaces.
4. Do not allow insulation to cover nameplates or code inspection stamps.
5. Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, and pipe sleeves, unless otherwise shown.
6. Install removable insulation sections on devices that require access for maintenance or equipment or removal, such as unions and strainer end plates.
7. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
8. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.
9. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
10. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Seal open ends of insulation with mastic. Sectionally seal butt ends of chilled water and condensate drain piping insulation at fittings and with white vapor barrier coating.
11. Install protective metal shields and rigid inserts where pipe hangers bear on outside of insulation.
12. Personnel Protection: Install on pipes from floor to 8 feet high. Install on pipes within 4 feet of platforms and to 8 feet high above platforms.

B. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.

C. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.

#### D. Placement

1. Slip insulation on pipe or tubing before assembly when practical to avoid longitudinal seams.
2. Insulate valves and fittings with sleeved or cut pieces of same material.

3. Seal and tape joints.
- E. Insulation at Hangers and Supports: Insulation or insulation inserts to be continuous through hanger or support.
- F. Heat Traced Piping: Apply insulation after heat-tracing work is completed and inspected.
- G. Roof Drains: Insulate vertical drops from roof drain to horizontal pipe, exposed and concealed horizontal piping, and 2 feet down on vertical risers from horizontal pipe.
- H. Roof and Overflow Drain Sumps: Insulate underside.
- I. Vapor Barrier
  1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
  2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
  3. Do not use staples and screws to secure vapor sealed system components.
- J. Aluminum Jacket
  1. Use continuous friction type joint to hold jacket in place, providing positive weatherproof seal over entire length of jacket.
  2. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
  3. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
  4. Do not use screws or rivets to fasten the fitting covers.
  5. Install removable prefabricated aluminum covers on exterior flanges and unions.
  6. Caulk and seal exterior joints to make watertight.

### 3.3 FIELD FINISHING

- A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.
- B. Apply pipe labels or banding to the finished insulation and not to the pipe where specified for a piping system.
- C. Finish Applications
  1. Piping Insulation (Concealed Areas): Factory finish.
  2. Piping Insulation (Exposed to View, Indoors): Type F1, PVC.
  3. Piping Insulation (Outdoors): Type F3, Aluminum.
- D. Painting Piping Insulation (Exposed to View)
  1. Metal or PVC jacketing does not require painting.
  2. If an insulated piping system is indicated to be painted, piping shall receive the following:
    - a. Prime coat in accordance with Section 09900 – Painting.
    - b. Finished insulation (and not the piping) shall be painted in accordance with Section 09900 – Painting.

\*\* END OF SECTION \*\*

SECTION 09900  
PAINTING

1 GENERAL

1.1 DESCRIPTION

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to accomplish all painting as specified herein and shown on the Drawings.

1.2 SCOPE OF WORK

- A. In general, work included under this section shall include the surface preparation, shop priming, field priming, and/or field painting of all exposed items and surfaces throughout the project, unless otherwise indicated.
- B. All exposed items and surfaces shall be painted using the appropriate coating system as specified herein. Coating system schedules and finish schedules may be provided herein and/or on the Drawings, which identify specific paint systems and paint colors to be used on specific items and surfaces. However, these schedules do not necessarily cover all items to be painted. Where the selection of a specific painting system for a particular application is not clear, it shall be the responsibility of the Contractor to request clarification from the Engineer.
- C. Surface preparation, priming, and coats of paint specified are in addition to shop priming and surface pretreatment specified in other sections, unless otherwise indicated.
- D. All exposed surfaces shall be painted except where the natural finish of the material is obviously intended to be the finished surface or if the surface is specifically noted not to be painted.
- E. In general, items to be painted include:
1. All exposed exterior surfaces including:
    - a. Concrete block.
    - b. Equipment supports.
    - c. Pipe, valves, fittings, hydrants, and appurtenances.
    - d. Ductwork and appurtenances.
    - e. Non-galvanized conduit and appurtenances.
    - f. Ferrous metals.
    - g. All factory primed steel doors and equipment.
    - h. Exposed untreated wood.
    - i. All other surfaces subject to corrosion.
  2. All exposed interior surfaces including:
    - a. All wall surfaces in all spaces unless specifically noted not to be painted.
    - b. All columns, equipment pads, pipe supports, and appurtenances.
    - c. Pipe, valves, fittings, hydrants, and appurtenances.
    - d. Ductwork and appurtenances.
    - e. All electrical conduit unless specifically noted not to be painted.
    - f. All hangers and supports for overhead items.
    - g. Ferrous metals.
    - h. All factory primed steel doors and equipment.
    - i. Exposed untreated wood.

- j. All other surfaces subject to corrosion.
  - 3. The interior of the existing influent pump station (all concrete, piping, ferrous metals, etc.)
  - 4. The interior of the influent pump station electrical building. The entire room shall be painted after modifications are made to the building.
  - 5. The interior of the new influent screen discharge box.
  - 6. The below grade exterior basement walls of the MBR Process Building.
  - 7. All new buildings in accordance with the Room Finish Schedule in the Drawings.
  - 8. The interior of the Chlorine Building. The entire room shall be painted after modifications are made to the building.
  - 9. Equipment that does not have an approved final coat or does not have the appropriate finished color as directed by the Engineer.
  - 10. Touch up all equipment that has been damaged by the existing construction as directed by the Engineer.
  - 11. Touch up all existing or new items and surfaces damaged by construction as directed by the Engineer.
- F. In general, items NOT to be painted include:
- 1. Items with Engineer approved factory finish.
  - 2. Electrical equipment unless specifically noted.
  - 3. Surfaces hidden from view including piping, conduit, ducts, and insulation. Note, the manufacturer's standard coatings, if any, may remain.
  - 4. Stainless steel surfaces except piping or tubing.
  - 5. Aluminum surfaces except:
    - a. Where specifically noted to be painted.
    - b. Where embedded in or in contact with concrete.
    - c. Where in contact with dissimilar metals.
    - d. Piping or tubing.
  - 6. Fiberglass surfaces except piping and piping appurtenances.
  - 7. Interior of pipe, ductwork, and conduits.
  - 8. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
  - 9. Code labels and equipment identification and rating plates.
  - 10. Exterior concrete or pre-cast concrete surfaces.
  - 11. Galvanized metal surfaces except interior conduit.
  - 12. Face brick, ceramic tile, plastic laminate.
  - 13. Concealed deck except where specifically specified to be painted.
  - 14. Pre-finished metal.
  - 15. Interior and exterior of concrete basins, vaults, and tanks unless noted otherwise.

### 1.3 DEFINITIONS

- A. Definitions of Painting Terms: ASTM D16, unless otherwise specified.
- B. Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch).

#### 1.4 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of the section titled "Submittals" of these specifications.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications:
  - 1. Product Data
    - a. Submit Manufacturer's product data for each coating, including generic description, complete technical data, surface preparation, and application instructions.
  - 2. Color Samples
    - a. Submit Manufacturer's color samples showing full range of standard colors.
- C. Manufacturer's Quality Assurance
  - 1. Submit Manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
- D. Warranty
  - a. Submit a complete description of the warranty to be provided.
- E. Painting Schedule
  - 1. Contractor shall submit a schedule of all items (structures, equipment, pipe, etc.) to be painted prior to beginning painting operations. Schedule shall include, but not be limited to, items to be painted, surface preparation, paint system, and color. The schedule shall be submitted to the Engineer for approval at which time the Engineer will select the colors to be used that are not specified herein or on the Drawings.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications
  - 1. Specialize in manufacture of coatings with a minimum of 10 years successful experience.
  - 2. Able to demonstrate successful performance on comparable projects.
  - 3. Single Source Responsibility
    - a. Coatings and coating application accessories shall be products of a single manufacturer.
- B. Applicator's Qualifications
  - 1. Experienced in application of specified coatings for a minimum of 5 years on projects of similar size and complexity to this work.
  - 2. Applicator's Personnel
    - a. Employ persons trained for application of specified coatings.
- C. Pre-application Meeting
  - 1. Convene a pre-application meeting two weeks before start of application of coating systems. Attendance of parties directly affecting work of this section, including Contractor, Engineer, Applicator, and Manufacturer's representative, is required. The meeting shall cover, but not be limited to, the following:
    - a. Environmental requirements.
    - b. Protection of surfaces not scheduled to be coated.
    - c. Surface preparation.
    - d. Application.
    - e. Repair.
    - f. Field quality control.



- g. Cleaning.
- h. Protection of coating systems.
- i. One-year inspection.
- j. Coordination with other work.

D. Manufacturer's Representative During Painting Operations

- 1. An authorized Manufacturer's representative shall be present at the start-up and weekly during painting operations. Such representative shall instruct and observe the Contractor's and Applicator's work and shall, at the completion of work, certify in writing to the Engineer that the Manufacturer's application recommendations have been adhered to. The cost of this work shall be borne by the Contractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery

- 1. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
  - a. Coating or material name.
  - b. Manufacturer.
  - c. Color name and number.
  - d. Batch or lot number.
  - e. Date of manufacture.
  - f. Mixing and thinning instructions.

B. Storage

- 1. Store materials in a clean dry area and within temperature range in accordance with Manufacturer's instructions.
- 2. Keep containers sealed until ready for use.
- 3. Do not use materials beyond Manufacturer's shelf life limits.

C. Handling

- 1. Protect materials during handling and application to prevent damage or contamination.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Weather

- 1. Air and Surface Temperatures
  - a. Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with Manufacturer's instructions.
- 2. Surface Temperature
  - a. Minimum of 5 °F (3 °C) above dew point.
- 3. Relative Humidity
  - a. Prepare surfaces and apply and cure coatings within relative humidity range in accordance with Manufacturer's instructions.
- 4. Precipitation
  - a. Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
- 5. Wind
  - a. Do not spray coatings if wind velocity is above manufacturer's limit.

B. Ventilation

1. Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D 102.

C. Dust and Contaminants

1. Schedule coating work to avoid excessive dust and airborne contaminants.
2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.8 TESTING EQUIPMENT

A. The Contractor shall furnish and make available to the Engineer the following items of testing equipment for use in determining if requirements of this section are being satisfied. Specified items of equipment shall be available for the Engineer's use at all times when field painting or surface preparation is in progress.

- a. Wet film gauge.
- b. Surface thermometer.
- c. Keane-Tator surface profile comparator.
- d. Set of National Association of Corrosion Engineers (NACE) visual standards.
- e. Holiday (pin hole) detector (low voltage).
- f. Sling-psychrometer.
- g. Magnetic dry film gauge.

2 PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers include:

1. Tnemec.
2. Induron.
3. Carboline.

B. Unless otherwise indicated, product names and numbers specified herein are manufactured by Tnemec. Equivalent materials produced by approved Manufacturer's shall be acceptable subject to prior review by the Engineer.

2.2 COATING SYSTEMS

A. General

1. Tnemec product names and numbers are specified herein. Equivalent materials produced by approved manufacturers shall be acceptable.
2. Exposure terms refer to the environmental conditions to which different surfaces may be exposed. A surface may exist in more than one exposure, e.g. an exterior wall can be categorized not only as "Exposed", but also as "Buried", where the exposure is below the grade line.

B. Coating Systems

1. Structural Steel – Interior Exposed
  - a. System Type: Epoxy/Epoxy
  - b. Surface Preparation: SSPC-SP6/NACE 3
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
  - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
  - e. Total DFT: 6 to 10 mils

2. Structural Steel – Exterior Exposed
  - a. System Type: Epoxy/Polyurethane
  - b. Surface Preparation: SSPC-SP6/NACE 3
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
  - d. Intermediate Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
  - e. Finish Coat: TNEMEC Series 1074 Endura-Shield, 2 to 5 mils DFT
  - f. Total DFT: 7 to 13 mils
3. Structural Steel – Below Grade (Buried) and Immersed
  - a. System Type: Epoxy/Coal Tar Epoxy
  - b. Surface Preparation: SSPC-SP10/NACE 2
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
  - d. Finish Coat: TNEMEC Series 46H-413 Hi-Build Tneme-Tar, 14 to 20 mils DFT
  - e. Total DFT: 17 to 25 mils
4. Galvanized Steel Pipe and Non-Ferrous Metal Pipe – Interior Exposed
  - a. System Type: Epoxy/Epoxy
  - b. Surface Preparation: Per manufacturer’s recommendation
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
  - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
  - e. Total DFT: 4 to 6 mils
5. Galvanized Steel Pipe and Non-Ferrous Metal Pipe – Exterior Exposed
  - a. System Type: Epoxy/Polyurethane
  - b. Surface Preparation: Per manufacturer’s recommendation
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
  - d. Finish Coat: TNEMEC Series 1075 Endura-Shield II, 2 to 3 mils DFT
  - e. Total DFT: 4 to 6 mils
6. Polyvinyl Chloride – Interior Exposed
  - a. System Type: Epoxy/Epoxy
  - b. Surface Preparation: Scarify
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
  - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
  - e. Total DFT: 4 to 6 mils
7. Polyvinyl Chloride – Exterior Exposed
  - a. System Type: Epoxy/Polyurethane
  - b. Surface Preparation: Per manufacturer’s recommendation
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
  - d. Finish Coat: TNEMEC Series 1075 Endura-Shield II, 2 to 3 mils DFT
  - e. Total DFT: 4 to 6 mils
8. Insulated Pipe – Interior/Exterior Exposed
  - a. System Type: Acrylic/Acrylic
  - b. Surface Preparation: Clean and Dry
  - c. Prime Coat: TNEMEC Series 1029 Enduratone (semi-gloss), 2 to 3 mils DFT

- d. Finish Coat: TNEMEC Series 1029 Enduratone (semi-gloss), 2 to 3 mils DFT
  - e. Total DFT: 4 to 6 mils
9. Cast-In-Place and Precast Concrete – Interior Exposed
- a. System Type: Epoxy/Epoxy
  - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 2-4, concrete cured a minimum of 28 days
  - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
  - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
  - e. Total DFT: 8 to 12 mils
10. Cast-In-Place and Precast Concrete – Exterior Exposed
- a. System Type: Waterborne Acrylate/Waterborne Acrylate
  - b. Surface Preparation: SSPC-SP13/NACE 6, clean and dry, concrete cured a minimum of 28 days
  - c. Prime Coat: TNEMEC Series 156 Enviro-Crete, 4 to 8 mils DFT
  - d. Finish Coat: TNEMEC Series 156 Enviro-Crete, 4 to 8 mils DFT
  - e. Total DFT: 8 to 16 mils
11. Cast-In-Place and Precast Concrete – Below Grade
- a. System Type: Coal Tar Epoxy
  - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 3, concrete cured a minimum of 28 days
  - c. Finish Coat: TNEMEC Series 46H-413 Hi-Build Theme-Tar, 14 to 20 mils DFT
  - d. Total DFT: 14 to 20 mils
12. Concrete Floors – Light Traffic, Low Impact
- a. System Type: Waterborne Epoxy/Waterborne Acrylic
  - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 1-3
  - c. Prime Coat: TNEMEC Series 287 Enviro-Pox, 3 to 4 mils DFT
  - d. Finish Coat: TNEMEC Series 287 Enviro-Pox, 3 to 4 mils DFT
  - e. Total DFT: 6 to 8 mils
13. Concrete – Secondary Containment
- a. System Type: Epoxy/Epoxy/Epoxy
  - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 3-9
  - c. Prime Coat: TNEMEC Series 201 Epoxoprime, 6 to 8 mils DFT
  - d. Intermediate Coat: TNEMEC Series 239SC ChemTread, 68 to 92 mils DFT
  - e. Finish Coat: TNEMEC Series 282 Theme-Glaze, 6 to 8 mils DFT
  - f. Total DFT: Nominal 125 mils

## 2.3 ACCESSORIES

### A. Coating Application Accessories

- 1. Accessories required for application of specified coatings in accordance with manufacturer's instructions, including thinners.
- 2. Products of coating manufacturer.

## 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions under which coating systems are to be applied. Notify Engineer of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

### 3.2 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

### 3.3 SURFACE PREPARATION OF STEEL

- A. Prepare steel surfaces in accordance with Manufacturer's instructions.
- B. Fabrication Defects
  - 1. Correct steel and fabrication defects revealed by surface preparation.
  - 2. Remove weld spatter and slag.
  - 3. Round sharp edges and corners of welds to a smooth contour.
  - 4. Smooth weld undercuts and recesses.
  - 5. Grind down porous welds to pinhole-free metal.
  - 6. Remove weld flux from surface.
- C. Ensure surfaces are dry.
- D. Immersed or Below Grade Surfaces
  - 1. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2.
- E. Exterior Exposed or Interior Exposed Surfaces
  - 1. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3.
- F. Interior or Immersed Surfaces, Severe Atmospheres
  - 1. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 5/NACE 1.
- G. Abrasive Blast-Cleaned Surfaces
  - 1. Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
- H. Shop Primer
  - 1. Prepare shop primer to receive field coat in accordance with manufacturer's instructions.

### 3.4 SURFACE PREPARATION OF GALVANIZED STEEL AND NONFERROUS METAL

- A. Prepare galvanized steel and nonferrous metal surfaces in accordance with Manufacturer's instructions.
- B. Ensure surfaces are dry.
- C. Remove visible oil, grease, dirt, dust, protective mill coatings, and other soluble contaminants in accordance with SSPC-SP 1 or Manufacturer's instructions as specified for coating system.
- D. Immersed Service
  - 1. Clean surfaces by abrasive blasting.
- E. Remove Rust From Galvanized Steel

1. Remove white rust from galvanized steel by hand or power brushing.
  2. Remove rust from old galvanized steel in accordance with SSPC-SP 2 or SP 3.
  3. Do not damage or remove galvanizing.
- F. Increase mechanical adhesion under moderate to severe conditions, such as exterior exposure or chemical environments, by abrasive blast and/or chemical cleaning.
- 3.5 SURFACE PREPARATION OF PVC
- A. Prepare PVC surfaces in accordance with Manufacturer's instructions.
  - B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
  - C. Scarify PVC surfaces.
- 3.6 SURFACE PREPARATION OF INSULATED PIPE
- A. Prepare insulated pipe surfaces in accordance with Manufacturer's instructions.
  - B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- 3.7 SURFACE PREPARATION OF CONCRETE
- A. Interior, Exposed
    1. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
    2. Allow concrete to cure for a minimum of 28 days.
    3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
    4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.
    5. Fill holes, pits, voids, and cracks with Tnemec 63-1500 Filler and Surfacer.
    6. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.
  - B. Exterior
    1. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
    2. Allow concrete to cure for a minimum of 14 days.
    3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
    4. Level concrete protrusions and mortar spatter.
    5. Fill hairline cracks less than 1/64 inch (0.4 mm) in accordance with Manufacturer's instructions.
    6. Prepare cracks wider than 1/64 inch (0.4 mm), moving cracks, gaps, and expansion joints in accordance with Manufacturer's instructions.
    7. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.
- 3.8 SURFACE PREPARATION OF CONCRETE FLOORS
- A. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
  - B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
  - C. Allow concrete to cure for a minimum of 28 days before coating.
  - D. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
- 3.9 SURFACE PREPARATION OF SECONDARY CONTAINMENT
- A. Prepare secondary containment surfaces in accordance with Manufacturer's instructions.

- B. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
- C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- D. Allow concrete to cure for a minimum of 28 days before coating.
- E. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.

### 3.10 APPLICATION

- A. Apply coatings in accordance with Manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- C. Keep containers closed when not in use to avoid contamination.
- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with Manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer.

### 3.11 REPAIR

- A. Materials and Surfaces Not Scheduled to Be Coated
  - 1. Repair or replace damaged materials and surfaces not scheduled to be coated.
- B. Damaged Coatings
  - 1. Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- C. Coating Defects
  - 1. Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

### 3.12 FIELD QUALITY CONTROL

- A. Applicator's Services
  - 1. Verify coatings and other materials are as specified.
  - 2. Verify surface preparation and application are as specified.
  - 3. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges.
  - 4. Coating Defects
    - a. Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
    - b. Check for holidays on interior steel immersion surfaces using holiday detector.
  - 5. Report
    - a. Submit daily written reports describing work performed, inspections made, and actions taken to correct nonconforming work. Daily reports shall contain, but not be limited to, the following information:
      - 1) Start date and time of work in each area.
      - 2) Weather conditions.

- 3) Date and time of application for each following coat.
- 4) Moisture content of substrate prior to each coat.
- 5) Provisions utilized to maintain temperature and humidity of work area with Manufacturer's recommended ranges.

- b. Report nonconforming work not corrected.
- c. Submit copies of report to Engineer and Contractor.

B. Manufacturer's Field Services

1. Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems and shall be available per paragraph 1.5.E.

3.13 CLEANING

- A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.14 PROTECTION OF COATING SYSTEMS

- A. Protect surfaces of coating systems from damage during construction.

3.15 ONE-YEAR INSPECTION

- A. Owner will set date for one-year inspection of coating systems.
- B. Inspection shall be attended by Owner, Contractor, Engineer, and Manufacturer's representative.
- C. Repair deficiencies in coating systems as determined by Engineer in accordance with Manufacturer's instructions.

3.16 PIPE CODING

- A. All process piping shall be color-coded. Pipe color and band color, when required, shall be in accordance with the Color Schedule of this section.
- B. Bands shall be spaced at maximum 6 feet on center. On pipe runs less than 6 feet in length, one band shall be located at the center of the run.

1. Place bands:

- a. Along continuous lines.
- b. At changes in direction.
- c. At changes in elevation.
- d. On both sides of an obstruction.

2. Band width shall be as follows:

- a. For pipes up to 8" in diameter: 2" minimum.
- b. For pipes 10" to 24" in diameter: 4" minimum.
- c. For pipes 30" to 48" in diameter: 6" minimum.
- d. For pipes greater than 48" in diameter: 8" minimum.

C. Pipe Labels

1. After painting of pipe work is completed, all pipe work shall have stenciled labels indicating the contents of the pipe (i.e. "HYPOCHLORITE SOLUTION").
2. Labels shall be placed on each side of the pipe (180 degrees from each other) and spaced at maximum 20 feet on center. Labels shall be placed such that they are in direct line of site. For pipe runs less than 20 feet, label shall be placed at the center of the run or the most visible location. Label may be omitted from one side of pipe if view is obstructed from that side.
3. When the flow in a pipe is in one direction at all times, flow direction arrows shall be placed in front of each label on the pipe.



4. The width of each letter shall be 80% of the height of each letter. The height of each letter shall be as follows:
  - a. For pipes  $\frac{3}{4}$ " to  $1\frac{1}{2}$ " in diameter:  $\frac{1}{2}$ " in height.
  - b. For pipes 2" in diameter:  $\frac{3}{4}$ " in height.
  - c. For pipes  $2\frac{1}{2}$ " to 6" in diameter:  $1\frac{1}{4}$ " in height.
  - d. For pipes 6" to 10" in diameter:  $2\frac{1}{2}$ " in height.
  - e. For pipes greater than 10" in diameter:  $3\frac{1}{2}$ " in height.
5. For pipes smaller than  $\frac{3}{4}$ " in outside diameter, use a laminated plastic or aluminum tag with the lettering etched or stamped and filled in with black or contrasting enamel.
6. Labels shall be black or white in color such that it is contrasting with the primary pipe color.

D. Equipment Labels

1. Where specified or directed by the Engineer, the Contractor shall label, in the same manner as the pipe, the individual units of equipment such as blowers, pumps, collector drives, compressors, silencers, etc. All push buttons, starters, switches, etc., when remote from the equipment, shall have labels of the engraved plastic type affixed to or adjacent to the remote switch, push button, starter, etc.

\*\* END OF SECTION \*\*

SECTION 11260  
ON-SITE HYPOCHLORITE GENERATION SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

- A. This section covers the necessary work by the Contractor, On-Site Sodium Hypochlorite Generator System (OSHGS) Supplier, Owner and Engineer, to furnish, install, test, and make ready for operation an OSHGS.
- B. The Generation System includes, but is not limited to, the Sodium Hypochlorite Generator Skid with integral piping, valves, system control cabinet with PLC, Water Softener, piping, valves, ancillary equipment as specified herein, related testing, start-up and training services.
- C. The OSHGS Supplier shall furnish an entire OSHGS consisting of the following major components:
  - 1. Sodium Hypochlorite Generation skid and electrolytic cells
  - 2. Heat exchanger
  - 3. Control cabinet, PLC, VFD's, networking communication components, and associated equipment
  - 4. Water Softeners & Cartridge Filters
  - 5. Acid cleaning Cart/System
  - 6. Booster Pump (if incoming water to generator below 50PSI)
  - 7. Spare parts

1.2 SYSTEM DESCRIPTION

- A. The supplied OSHGS will be required to supply 800 Pounds Per Day (PPD) of Free Available Chlorine (FAC). The OSHGS shall generate an aqueous solution of a minimum concentration of 0.8 percent ( $\pm 0.05\%$ ) by weight sodium hypochlorite expressed as chlorine. The minimum capacity shall be demonstrated to be equal to the capacity specified for each installation while not exceeding the maximum aggregate raw material quantities specified below. Each Electrolytic Cell shall consume between 2.5-3.5 pounds of salt per pound of chlorine output, using solar salt with no additives (organic binders, flow control agents, resin cleaning material, etc.), and meeting the following specifications:
  - 1. Sodium Chloride (dry basis): 99.7% minimum
  - 2. Insolubles: 0.15% maximum
  - 3. Surface Moisture: 0.20% maximum
- B. The electrolytic cell shall consume 1.8-2.4 AC kilowatt-hours of electricity per pound of chlorine equivalent output.
- C. Expected water consumption will be in the range of 14.0-17.0 gallons per pound of chlorine equivalent output. Water temperature must measure between 55 °F and 78 °F. Higher temperature water will result in lower system efficiency and higher total consumable units. A minimum of 50 psi water pressure is required at the inlet to the water softener. The raw water supply to the softener must be potable.
- D. Generator performance is to be measured as a function of total consumption for salt and power. Expected ranges of consumption for salt will be 2.5-3.5 pounds of salt and 1.8-2.4 KWH per pound of equivalent chlorine (PPE). Product concentrations will be in the range of  $0.80\% \pm 0.05\%$ .
  - 1. Performance will be measured as the sum of the unit measurements for salt (PPE) and power (KWH/PPE) and will not exceed 6.0 consumable units. Example: salt consumption at 3.0 PPE and 2.0 KWH/PPE will measure 5.0 consumable units and will be considered proper performance.

2. Note that electrolytic cells require an initial acclimation period of approximately 300 operational hours. Performance measured before the cells have completed this exercise may not satisfy specification requirements. Water softener salt consumption and or chiller or heater power consumption shall be excluded from performance calculations.
3. The only liquid waste product allowed from the OSHGS will be the periodic backwash discharge from the water softener.

### 1.3 RELATED SECTIONS

- A. All electrical, mechanical, metal, painting and instrumentation work included herein shall conform to the applicable Sections or Divisions of this project except as otherwise shown or specified.

### 1.4 QUALITY ASSURANCE

#### A. OSHG System Supplier Requirements

1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:
  - a. Assume full responsibility for the completeness and proper operation of the OSHG.
  - b. Have experience, be reputable, and be qualified in designing and manufacturing on-site hypochlorite generation equipment.
  - c. Have current NSF Standard 61 Certification for the generation skid being offered.
  - d. Have at least 15 years' experience with on-site sodium hypochlorite generation equipment ranging in capacity from 20 to 2400 pounds per day of 100% chlorine equivalent.
  - e. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The OSHG shall be pre-assembled, piped, and factory-tested to assure compliance with all operational requirements. The OSHG shall be shipped as a single unit. Loose hypochlorite generation components shall not be acceptable. No field assembly or wiring will be permitted with the exception of external conduits. Equipment footprint as shown on the drawings shall not be exceeded.
  - f. Have at least ten similar OSHG Systems in operation for at least five years.
2. To ensure quality and complete unit responsibility, the OSHG must be assembled and inspected by the OSHGS Supplier at its facility. The complete OSHG must be a standard and regularly-marketed product of that manufacturer. The OSHG Supplier must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.
3. The Owner reserves the right to be present at the fabricator's facility for visual inspection of equipment to be supplied.

#### B. Specified Manufacturer

1. On-site Sodium Hypochlorite Generation System shall be:
  - a. Microclor® as manufactured and supplied by PSI Water Technologies, Inc., Campbell, California, (408) 370-6540.
  - b. Approved equal as required by this specification
2. Microclor® is the basis of design. Contractors are responsible for all additional costs associated with selection, design, and installation of an alternate manufacturer, including revision of Contract Drawings (mechanical, process, etc.).

#### C. Warranty

1. Prior to acceptance of the Sodium hypochlorite generator system, provide written warranty from the OSHGS Supplier that includes the following statements:

- a. OSHGS Supplier has inspected the installation during and after completion and the sodium hypochlorite generator system is free from faults and defects and is in conformance with the Contract Documents.
- b. The warranty period shall start from the date of commissioning of the system.
- c. Principal components of the sodium hypochlorite generator system will remain free of defects for a period of three (3) years from the date of final acceptance and all other equipment supplied for one (1) year.
- d. The electrolytic cells including cell body shall have a three (3) year full replacement warranty and a prorated straight-line replacement warranty for years 4-7 from the date of final acceptance.

#### D. Pre-Approval Submittals

1. Each supplier submitting an alternate to the equipment defined herein shall provide the following submittals 20 days prior to the established bid date. Failure to provide a complete and thorough submittal package shall render their preapproval request non-responsive and will not be considered. Approval of manufacturers will be at the sole interpretation of the Engineer. A blanket statement that equipment proposed will meet all requirements will not be sufficient to establish equivalence to the specified manufacturer(s). If requested by the Engineer, the supplier must be prepared to demonstrate a unit similar to the one proposed. The following information is required:
  - a. A complete set of drawings as described in Section 1.3.5. Provide a minimum of one drawing per system clearly showing how the proposed system will fit on the site.
  - b. A reference list of no less than ten installations of the type and size of system proposed. The installations must have been in service for a minimum of five years. The list shall include the following information: Owner name and accurate contact information, placed in service date, and design conditions including generation capacity. Provide graphical performance data from a minimum of ten systems showing that the raw materials consumption levels satisfy the requirements of Section 1.2. Failure to submit references for similar systems may deem the pre-approval request "non-responsive" and will be rejected without further review.
  - c. If the alternate OSHGS Supplier's hydrogen handling and safety equipment design differs in any way from Section 2.2, they must submit a statement signed by a corporate officer stating they have never had a hydrogen related cell rupture incident. Failure to submit this statement may deem the request for pre-approval "non-responsive" and will be rejected without further review.
  - d. It shall be the supplier's responsibility to carefully examine each item of the specifications. Failure to offer a complete submittal or failure to respond to each section of the technical specifications will cause the pre-approval to be rejected without further review as "non-responsive." All exceptions and/or deviations shall be fully described in the appropriate section. Deceit in responding to the specifications will be cause for automatic rejection. The supplier must include a separate sheet listing any and all deviations to the specifications. The Engineer understands that manufacturers design systems with different features. This listing is therefore integral to the Engineer's determination of an equivalent product. Each deviation must reference the listed specification, by number if necessary, and explain in full detail how the proposed system is different.

#### E. Product Submittals

1. The following product data shall be electronically submitted by the OSHGS Supplier for review and approval by the Engineer that the product provided conforms to the site-specific requirements prior to the fabrication of the systems:
  - a. Process and instrumentation diagram for the systems.

- b. Shop drawings and catalog literature showing dimensional information and details of piping, fabrication, and erection of all materials and equipment furnished under this section, including:
  - 1) Detailed drawings of tank nozzle orientations provided.
  - 2) Detailed drawings of equipment installations provided.
- c. Scaled drawing of general layout, general arrangements, and major system components, including:
  - 1) Dimensions, including those for system connections
- d. Drawings showing fabrication, assembly, installation, and wiring diagram. Wiring diagrams for the electrical control panel and rectifier transformer shall consist of, at a minimum, control schematics, including coordination with other electrical devices operating in conjunction with the OSHGS.
- e. Manufacturer's literature, illustrations including weight and dimensions, specifications, materials of construction, and bill of materials for each component of the system. Data shall include a complete description in sufficient detail to permit comparison with the technical Specifications. Major system components include:
  - 1) Water softener
  - 2) Brine pump
  - 3) Hydrogen dilution blower
  - 4) Miscellaneous instrumentation, valves, and accessories
- f. Performance data: for each pump and blower furnish a performance certification indicating:
  - 1) Pressure
  - 2) Capacity
  - 3) Efficiency
  - 4) Horsepower
- g. Motor data: for each motor furnish a certified motor data sheet for the actual motor or for a previously manufactured electrically duplicate motor which was tested.
- h. Control philosophy including I/O list and loop descriptions.
- i. The acceptable range of water pressure for proper system operation. If a pressure or flow regulator is required, it shall be provided.
- j. A list of all parameters, ratings, or other characteristics where the proposed Sodium hypochlorite generator system deviates from the requirements set forth in these Specifications.
- k. Installation instructions.
- l. Performance testing protocol including a recommended test plan, measurement methods, and sample data sheet showing all pertinent process data to be recorded and the frequency and data readings.
- m. Current NSF Standard 61 Certification for the generation skid being offered.
- n. References for at least ten similar units that have been installed and have been operational for at least five years of continuous service.
- o. Affidavits of compliance with referenced standards and codes.

F. Operation and Maintenance Manuals

- 1. Detailed operation and maintenance (O&M) manuals shall be provided by the Supplier to the Engineer for review and approval. At a minimum, the following shall be included:
  - a. Required Operation Data.

- 1) Complete, detailed operating instructions for each piece of equipment.
  - 2) Explanations for all safety considerations relating to operations.
  - 3) Recommended spare parts lists.
- b. Required Maintenance Data.
- 1) All information and instructions required by plant personnel to keep equipment properly cleaned, lubricated, and adjusted so that it functions economically throughout its full design life.
  - 2) Maintenance summary forms.
  - 3) Explanation with illustrations as necessary for each maintenance task
  - 4) Recommended schedule of maintenance tasks.
  - 5) Lubrication charts and table of alternate lubricants.
  - 6) Troubleshooting instructions.
  - 7) List of maintenance tools and equipment.
  - 8) Name, address, and phone number of manufacturer and manufacturer's local service representative for major system components.

#### G. Manufacturer Services

1. Prior to scheduling services by the OSHGS Supplier, the Contractor shall verify the equipment installation and provide the completed installation checklist with photo documentation. Upon receipt of the completed installation checklist with photo documentation, the OSHGS Supplier shall schedule start-up and training to take place no sooner than two (2) weeks. The Contractor shall coordinate testing requirements and scheduling with the Engineer.
2. The OSHGS Supplier shall be present at each jobsite for the following time period after the system is installed, travel time excluded:
  - a. Certification of proper installation, system startup, and functional testing.
    - 1) Installation inspection shall include supervising the correction of any defective or faulty work before acceptance by Owner.
    - 2) System startup shall include testing, calibrating, and adjustment of all components for optimum performance.
    - 3) Functional testing shall include inspection of integration of the provided equipment's controls to the Owner's SCADA system, etc.
  - b. Training Owner's personnel and providing detailed instructions in the operation, maintenance, and troubleshooting for the system.
    - 1) Upon request, a training manual will be provided with an outline of the training procedures.
  - c. Services shall be provided by a technician that is factory-trained by the OSHGS Supplier and has demonstrated ability and experience in the installation and operation of the equipment.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. The OSHGS shall be packaged and shipped so as not to incur damage to any portion of the equipment through handling and installation of the system itself.
- B. The Contractor shall be responsible for the delivery, storage, and handling of products in accordance with the OSHGS Supplier's recommendations.
- C. The Owner shall inspect all equipment and materials against approved Shop Drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to the OSHGS Supplier for replacement or repair.

- D. Equipment and materials shall be stored in a dry, chemical-free location and protected from the elements according to the OSHGS Supplier's instructions.
- E. Equipment and materials shall be handled in an approved manner according to the OSHGS Supplier's instructions.

## 2 PRODUCTS

### 2.1 ON-SITE SODIUM HYPOCHLORITE GENERATION SYSTEM

- A. A transformer rectifier, electrolytic cells, water solenoid valve, brine solenoid valve, brine pump, rectifier cabinet, hydrogen dilution blower, and a PLC-based control panel containing system controls, water softener with flow meter, and all necessary interconnecting wiring and hardware shall form a complete on-site sodium hypochlorite generation system. Components of the OSHGS shall comply with this specification. All components of the electrolytic cell skid shall be pre-assembled, piped, wired to input and output, flanged, threaded, etc. connections located at easily accessible points on the skid. The installation contractor shall provide all interconnecting piping and conduit, which shall be Sch 80 PVC. The OSHGS shall be factory-tested prior to shipping as one self-contained unit.

### 2.2 HYDROGEN SAFETY MANAGEMENT

- A. The generators shall have no waste products associated with its use other than hydrogen gas, which is to be vented to the atmosphere. Hydrogen Dilution blowers will be used to purge all residual hydrogen out of the system and storage tanks and dilute the hydrogen concentration 100 to 1 or below 25% of the LEL.
- B. Any proposed system must meet every operational and material aspect of this specification. Hydrogen management shall be accomplished by the passive venting of each electrolytic cell without potential restrictions. This flow path should not have baffle plates, orifice plates or backpressure valves between the last point of product generation and atmospheric evacuation.
- C. The presence of over-pressure rupture disks is not acceptable as the initiation of disk rupture would render the system inoperable. No hydrogen shall be vented directly to the hypochlorite storage tank where an accumulation could occur.
- D. Under no circumstance will waste hydrogen be allowed to flow from one cell or cell compartment to the next. All hydrogen must immediately be released from each cell pack.
- E. Minimum passive venting capability from each electrolytic cell pack shall be 4.0 square inches for every 100 pounds of chlorine production.
- F. The hydrogen dilution system shall dilute the hydrogen concentration to below 25% of the LEL or 1% by volume.
- G. Generator skid hydrogen dilution shall include passive vents connected to each cell and blower connected to the vent header. Sodium hypochlorite storage tanks shall be evacuated by blower.
- H. Under no circumstance will the Hydrogen Safety Management requirements (Part 2.2) be relaxed or modified as they are critical operator safety features and core to the generator design. **NOTE: THIS HYDROGEN SAFETY DESIGN MUST BE MET, REGARDLESS OF ONSITE GENERATOR MANUFACTURER SELECTED, AND WILL BE REQUIRED FOR SUBMITTAL APPROVAL.**

### 2.3 ELECTROLYTIC CELL SKID ASSEMBLY

- A. An electrolytic cell skid assembly, hydrogen dilution blower, supporting electrical equipment, and sufficient area for maintenance must fit within the following dimensions:
  - 1. Length: 192 inches
  - 2. Depth: 48 inches
  - 3. Height: 80 Inches

- B. Each electrolytic cell skid assembly shall have the following components and features:
1. 316 Stainless steel brine gear pump,
    - a. Magnetic Drive
    - b. Cavity style design
    - c. PEEK gear construction
    - d. Integral speed control
    - e. Series GJ by MicroPump
  2. Water solenoid valve.
  3. Polycarbonate water and brine rotameters.
  4. Electrolytic cells
  5. Transformer rectifier.
  6. Magnetic flow meter.
  7. Optical level switches.
  8. Temperature switches.
  9. Temperature sensor.
  10. Teflon and Kynar interconnecting tubing.
  11. 304 stainless steel frame, electrolytically polished for passivation, corrosion resistance, and chemical compatibility.
    - a. Horizontal and vertical tube sections shall be of .125-inch wall thickness.
    - b. All vertical and horizontal frame connections shall be welded.
    - c. The completed frame with all mounted components shall comply with the UBC structural requirements for seismic zone four.
- C. The generator shall be factory wired, plumbed, and mounted on a self-contained skid assembly.
- D. The generator will be designed and built to allow one of the five electrolytic cells to be removed (replaced with a pipe spool) and still run at 80% production capacity.
- E. Each electrolytic cell shall be arranged so that it can be completely drained in place.
- F. The rack mounted flow control panel will consist of a water rotameter, water sensor, brine rotameter and a positive displacement gear pump with variable speed drive.
- G. The variable speed drive will respond to a 0-5 VDC signal generated by the PLC algorithm in order to maintain constant current relative to variable water temperature or flow rate.
- H. The process shall operate in a batch environment allowing for consistent hypochlorite concentrations and greatest efficiencies.
- I. The generator skid will be supplied with a 4-20 mA electrolyte temperature sensor that will function to return a linear signal proportional to 0-100°C, which will allow continuous operation up to 130°F without interruption. Under no circumstance will bimetallic “snap” switches be permitted as the primary over-temperature sensor.
- J. The generator package shall have the following redundant interlocked safety features:
1. Cell high temperature switch.
  2. Low level switch for each cell.
  3. Water flow sensor.
  4. Transformer high temperature switch.
  5. Automatic current regulation.



- K. All electrical equipment and enclosures will be built and certified to UL 508 standards and will possess the appropriate label
- L. The generation system shall be pre-piped and skid-mounted.
  - 1. The OSHGS skid frame shall be constructed of 304 stainless steel tube for structural strength. Horizontal and vertical tube sections shall be of .125-inch wall thickness and have a depth no greater than twenty four inches by a length not exceeding six feet. The entire skid shall undergo electrolytic polishing for ultimate passivation, chemical compatibility, and corrosion resistance. The completed frame with all mounted components shall comply with the UBC structural requirements for seismic zone four.
  - 2. The skid frame shall be configured to allow easy access to all components, including the electrolytic cells. All vertical and horizontal frame connections shall be welded. Under no circumstances can water/liquids handling and/or cells be located immediately above the power supplies. The skid frame shall support, as a minimum, the following mounted equipment:
    - a. Generator electrolytic cells
    - b. Power supply/rectifier
    - c. Water and brine rotameters
    - d. Control panel
    - e. Interconnect pipes valves and fittings
    - f. Interconnect conduit and wiring
    - g. Water flow sensor
    - h. Variable-speed, positive-displacement brine pump

#### 2.4 ELECTROLYTIC CELLS

- A. Multiple electrolytic cells shall be provided as follows:
  - 1. Cell Quantity: 5
  - 2. Cell Capacity: 160 ppd
  - 3. Active Surface: 12" x 16"
- B. Any system using fewer electrolytic cells must demonstrate its ability to achieve 80% production capacity with one electrolytic cell removed from service.
- C. The electrolytic cell bodies shall be constructed of and clear acrylic materials, allowing for front and rear visual inspection of the electrodes from all angles.
- D. Each electrolytic cell shall be constructed utilizing DSA coated titanium anodes and titanium cathodes. The cells shall be configured in a vertical format with a recirculating loop provided for each cell. This recirculating loop will also allow the passive removal of hydrogen from each cell via the upper hydrogen vent. Under no circumstance will hydrogen be allowed to be driven from one cell or cell loop to the next.
- E. Each cell loop shall also incorporate an optical level sensor, so as to preclude any possibility of exposing an active electrode surface.
- F. The wetted cell components shall consist only of the electrodes and acrylic cell body. No internal baffles, spacers, or connecting hardware will be allowed.
- G. Cells shall utilize titanium bolting hardware.

#### 2.5 TRANSFORMER RECTIFIER

- A. The 6-pulse D.C. Rectifier will consist of a fully isolated three phase step down transformer and bridge rectifier. D.C. voltage output will be fixed with multiple primary taps for + 5-10% voltage correction. Under no circumstance will switching rectifiers or phase angle fired SCR voltage correction be permitted. D.C. ripple will be less than 4% with a power factor of 99% or better.

- B. The transformer rectifier shall be a fixed voltage unit where the current will be allowed to float as a function of electrolyte conductivity.
  - 1. Constant current shall be achieved via an active feedback loop where rectifier amperage is measured and reported to the PLC. The control algorithm calculates the appropriate amount of brine to mix with the incoming water so as to maintain constant current.
  - 2. SCR-controlled rectifiers shall not be allowed.
- C. Rectifier efficiency shall be 97% or greater.
- D. The transformer/rectifier shall house a 4-20 mA D.C. current transducer and NEMA 4X digital display of amperage.
- E. The rectifier cabinet and base frame shall be constructed of 304 Stainless Steel and will be of a modular design. All internal wiring connections and components shall be easily accessible by removing the front access panel.
- F. The transformer enclosure shall be removable from the skid assembly as one piece, allowing for unobstructed access to the transformer.
- G. The transformer rectifiers shall be designed for the following operating conditions:
  - 1. Capacity (KVA): 96
  - 2. Primary Voltage: 480VAC/3 PH/175A
  - 3. Secondary Voltage: 300VDC @ 320ADC
- H. The stepdown transformer rectifier shall be provided with the following accessories:
  - 1. DC bridge rectifier utilizing three diode assemblies and an aluminum heat sink with 120 VAC cooling fan.
  - 2. Panel-mounted electrical disconnect switch.

## 2.6 ELECTRICAL CONTROL PANEL

- A. The OSHGS Supplier shall provide a NEMA 4X, 304 stainless steel, electrical control panel, which shall include controls for the entire sodium hypochlorite generation and feed system. The panel shall be mounted onto the generator skid and pre-wired at the factory to system components. The control panel shall house the operator interface terminal (OIT), PLC, hydrogen blower controls, and terminal strips to fully support the functions of generator operation, tank level, and metering pump proportional control.
- B. All controls and operations logic specified herein and as shown on the instrumentation loop diagrams required for the system shall be programmed in a Programmable Logic Controller (PLC). The control cabinet logic will function at the PLC level where operating parameters will be measured, corrected, scaled, reported, and controlled. Contractor shall coordinate with OSHGS Supplier and instrumentation supplier for proper integration of the system.
- C. The control panel shall display all relevant operating parameters and/or alarm conditions. The OIT will serve as the operator interface, data input screen, and alarm log.
- D. At a minimum, the panel shall have the following features, components, and functionality:
  - 1. The generator shall automatically start and stop based on the high and low levels in the sodium hypochlorite storage tank.
  - 2. The generator shall shut down and alarm for the following conditions:
    - a. Low electrolyte level in cell.
    - b. Hypochlorite temperature exceeds 130°F (55°C).
    - c. Inlet flow falls below a preset value.
    - d. Rectifier high or low amperage.
    - e. Rectifier high temperature.
    - f. Hydrogen dilution blower failure.

3. Low-low level alarm for hypochlorite storage tank.
  4. High-high level alarm for hypochlorite storage tank.
  5. Enclosure cabinet, 30" x 30" x 10", with ample interior volume so as to be easily wired and serviced.
  6. 12.1" color touchscreen human-machine interface (HMI) with dedicated screens, including help dialogs covering all basic operations and detailed alarm explanations, for each portion of the process and Ethernet communications for PLC connection.
  7. Allen Bradley MicroLogix 1400 programmable logic controller (PLC) with Ethernet communication protocol.
  8. Rectifier controls.
  9. Blower controls.
  10. Analog inputs from the flow meter and residual analyzer to drive each VFD based on the appropriate flow, residual, or compound loop algorithm.
    - a. Under no circumstances will external controllers be allowed to control the VFD output.
  11. Logging and storing alarm history.
  12. Security protection.
  13. Dedicated 24 VDC power supply for PLC and HMI.
  14. Emergency stop pushbutton.
  15. Cabinet-mounted electrical disconnect switch.
  16. Start-up shall be accomplished without the need for a laptop computer or proprietary software.
- E. The OSHGS Supplier shall be responsible for programming the Generation System package control software. The OSHGS Supplier shall deliver to the Owner all PLC and HMI code for future reference prior to final acceptance.

## 2.7 HYDROGEN DILUTION BLOWER

- A. A hydrogen dilution blower shall be designed for the following operating conditions:
1. Capacity: 812 ACFM
  2. Static Pressure: 3.82 in. WC
  3. Motor HP: 3 HP
  4. Electrical Service: 480V, 3 Phase, 60Hz
- B. The blower shall be AMCA type B spark resistant of cast aluminum construction. The blower shall be cast with commercial grade 319 cast aluminum, having a 3/16" minimum wall thickness. Housing halves should be attached with tapered lugs having a minimum 45-degree taper from centerline for additional strength. Inlets and outlets shall be round.
- C. The blower wheel hub shall be an integral part of the wheel casting. The wheel shall be a radial-type wheel. The blower shall be statically balanced by removal of material only – no additional weights are to be used in the balancing process.
- D. The blower shall be arrangement 4 with a base of 12-gauge steel (minimum).
- E. Hydrogen dilution blower shall be PB Series by Cincinnati Fan or equal.
- F. The hydrogen dilution blower shall be provided with the following accessories:
1. Inlet guard.
  2. Teflon shaft seal.
  3. Current sensor.
  4. Differential pressure switch positioned in the dilution ductwork vent stack.

5. Software controlled safety interlocks to detect control system sequence failure.

## 2.8 WATER FILTER

- A. A wall-mounted large-capacity cartridge type filter housing holding a 10" cartridge for dirt, rust, and particulate matter from softener's feed water shall be provided. The filter housing shall feature NPT inlet and outlet connections and a mounting bracket that must be non-metallic construction. A polypropylene cap with Buna-N O-ring shall be supplied.
- B. The filter cartridge shall be a 4-1/2" diameter, 50-micron, disposable cartridge. Cartridge shall be manufactured from a pleated non-woven and reusable polyester fabric with polypropylene core.
- C. Two (2) pressure gauges shall be provided to measure the pressure drop across the filter.

## 2.9 WATER SOFTENER

- A. A dual-tank automatic water softening system shall be provided to remove hardness in the feed stream to the OSHGS, plus provides brine water makeup. The softener shall be designed for the following operating conditions:
  - 1. Dual Tank Dimension: 16" Diameter x 71.75" H
  - 2. Efficiency: 4,000 grains exchanged per pound of salt
  - 3. Kinetico Model No.: CP-216S
- B. Softener shall remove hardness to less than 1/2 gpg. One tank will be on-line during service. A water meter shall automatically initiate system regeneration. The water meter shall measure the processed volume and be adjustable. Water softeners that regenerate on a fixed time will not be acceptable. When the ion exchange capacity of one resin tank is nearly exhausted, the hydraulically-driven, flow-controlled switchover valve will automatically divert flow to the alternate tank while initiating brine backwashing of the first tank for regeneration of the ion exchange resin. During regeneration cycles, one tank shall provide water to service and to the regenerating tank. Regeneration shall use salt solution from the brine tank.
- C. The regeneration control valve shall be top mounted (top of media tank), and manufactured from non-corrosive materials. Control valve shall not weigh more than four pounds. Control valve shall provide service and regeneration control for two media tanks. Inlet and outlet ports shall accept a quick connect, double O-ring sealed adapter. Interconnection between tanks shall be made through the regeneration valve with a quick connect adapter. Control valve shall operate using a minimum inlet pressure of 25 psi. Pressure shall be used to drive all valve functions. No electric hook-up, electric timers, or gear motors shall be required. Control valve shall incorporate four operational cycles including; service, brine draw, slow rinse, and a combined fast rinse and brine refill. The brine cycle shall flow shall be opposite the service flow, providing a countercurrent regeneration. Control valve shall contain a fixed orifice eductor nozzle and self-adjusting backwash flow control. The control valve will prevent the bypass of hard water to service during the regeneration cycle.
- D. The tanks shall be designed for a maximum working pressure of 125 psi and hydrostatically tested at 300 psi. Tanks shall be made of polyethylene and reinforced with fiberglass wrapping. Each tank shall include a 2.5 in. threaded top opening. Upper and lower distribution system shall be of a slot design. Distributors will provide even flow of regeneration water and the collection of processed water.
- E. Each softener shall include a non-solvent, high capacity cation resin having a minimum exchange capacity of 30,000 grains/ft<sup>3</sup> when regenerated with 15.0 lbs/ft<sup>3</sup>. The media shall be solid, of a proper particle size and shall contain no plates, shells, agglomerates or other shapes, which might interfere with the normal function of the water softener.
- F. The water softener shall be provided with the following accessories:
  - 1. 1-1/2-inch inlet and outlet pipe connections.
  - 2. 1/2-inch HDPE tube with in-line check valve for feeding brine for regeneration.
  - 3. 1/4-inch wastewater discharge to sewer for backwash waste.

## 2.10 HEAT EXCHANGER

- A. If the incoming feed water to the generator is less than 55 °F, a heat exchanger shall be provided.
- B. A titanium and PVC heat exchanger will be provided on the OSHGS rack capable of raising the incoming cold water temperature 8-12°F.
- C. The process will function to bleed waste heat from the product hypochlorite to the incoming cold water.
- D. A bypass valve will be provided for seasonal adjustment. Additionally, a flushing valve and drain will be provided.
- E. All wetted components and fasteners will be titanium and all internal gasketing will be flourocarbon.
- F. The heat exchanger will not require power or control circuitry and will function in a completely passive fashion.

## 2.11 HYDROGEN DETECTOR

- A. A hydrogen gas monitoring system shall be provided to continuously measure and display gas concentration and provide alarms when preset limits are exceeded. A transmitter will send the signal to the control panel.
- B. The gas monitoring system shall have a NEMA 4X enclosure and two-line, eight-alphanumeric character LCD display with linear 4-20 mA output signal.
- C. The gas detector shall be model CN06 by Conspec Controls.

## 2.12 ACID CLEANING SYSTEM

- A. A pre-assembled, mobile cart including acid cleaning tank and centrifugal pump shall be provided by the OSHGS Supplier for periodic washing of the electrolytic cells.
- B. The cart shall be pre-piped and pre-wired prior to shipment. All piping, fittings, and valves shall be Sch 80 PVC. The 120VAC, single-phase plug shall be included for connection to a standard electrical receptacle.
- C. A discharge hose, quick-connect couplings, and appurtenance shall be included to transfer acid to and from the electrolytic cells.

## 2.13 TOOLS, SPARE PARTS, AND MAINTENANCE MATERIALS

- A. The OSHGS Supplier shall furnish one set of the following spare parts for each onsite sodium hypochlorite generator system:
  - 1. One (1) electrolytic cell level switch
  - 2. Two (2) electrolytic cell temperature sensors
  - 3. Two (2) brine pumps
  - 4. Two (2) electrolytic cell optical level sensors
- B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the completion of the contract.
- C. The OSHGS Supplier shall furnish an initial supply of all greases and lubricants required to start operations. Supply an amount of these materials necessary for one year of continuous operation.

## 3 EXECUTION

### 3.1 FACTORY ASSEMBLY AND TESTING

- A. The OSHGS shall be pre-assembled at the manufacturing location.

- B. System shall be tested for a minimum of eight hours at the location of assembly to assure it is in full compliance with the requirements of the specific design for the project and this specification.
- C. Factory testing shall include visual inspection of all equipment, complete assembly, and functional testing of equipment including leak testing, piping and instrumentation check, verification of control panel wiring and operation, and confirmation of proper operating parameters.
- D. Engineer and/or Owner reserve the right to be present at the OSHGS Supplier's manufacturing facility to witness factory testing. Engineer and/or Owner shall provide intent to witness factory testing at the time of the design submittal review and approval, and OSHGS Supplier shall provide notice to Engineer and/or Owner regarding the scheduled time of the factory testing at least five business days in advance of the proposed factory test.
- E. The OSHGS Supplier shall maintain Quality Control documentation that includes system test settings and measured performance.

### 3.2 INSTALLATION

- A. Installation of the generator, tanks, metering pumps, and appurtenances shall be performed by the Contractor and shall be in accordance with the Drawings and with the OSHGS Supplier's instructions and recommendations. Conflicts of information shall be called to the attention of the Engineer. It is the Contractor's (or Owner's) responsibility to provide:
  - 1. Water piping and valves from source to water softener, if applicable, and from softener to brine tank and electrolytic cell skid.
  - 2. Brine piping and valve from brine tank to electrolytic cell skid.
  - 3. Sodium hypochlorite piping and valves from electrolytic cell skid to sodium hypochlorite storage tank(s), from sodium hypochlorite storage tank(s) to metering pump(s), and from metering pump(s) to point of application.
  - 4. Vent piping, valves, and stack from hydrogen dilution blower to electrolytic cell skid vent connection and onwards.
  - 5. Vent piping, valves, and stack from hydrogen dilution blower to sodium hypochlorite storage tank(s) and onwards.
  - 6. All overflow and drain piping and valves.
  - 7. Electrical connections, wiring, and conduits to/from system control panel for power, control, and alarm interfaces with remote located instruments (tank level and pressure transmitters, etc.), plant SCADA, etc.
    - a. All wiring to be TTHN stranded wiring and will conform to the most current version of the National Electric Code.
    - b. All 4-20 mA instrumentation wiring will be 2- or 4-conductor shielded cable.
    - c. Instrumentation and signal/control wiring will be run in conduits separated from all other AC wiring systems.
  - 8. Gaskets, seals, and O-rings for hypochlorite service shall be constructed of Hypalon, PTFE, or FKM. Santoprene or neoprene shall be used for brine service. EPDM shall be used for water and ammonia.
  - 9. Any necessary unistrut, hangers, supports, etc. for Contractor-supplied piping and conduits.
  - 10. Anchor bolts, suitable concrete mounting pads and other incidentals as necessary to complete the installation.
  - 11. Pressure testing of all interconnecting piping as is practical or directed by the Owner.
  - 12. Flushing of all piping with potable water prior to system start-up and commissioning to remove materials that may have entered as a result of the installation process.

- B. All equipment units or assemblies shall be installed on concrete bases and secured with anchor bolts in accordance with the OSHGS Supplier's recommendations and as shown. Contractor shall be responsible for the design of the equipment pads. The contractor shall coordinate with OSHGS supplier for skid placement and anchoring.
- C. Contractor shall inspect all concrete pads for proper elevation, dimensions, cutouts, evenness and anchor bolt locations and correct if necessary.
- D. The Contractor shall inspect all equipment before installation, if damaged; notify the Engineer and OSHGS Supplier promptly. Do not install damaged equipment until the OSHGS Supplier makes repairs in accordance with OSHGS Supplier's written instruction and approval.
- E. The Contractor shall, after installation of storage tanks is complete but before piping connections are made, block all outlets and fill each tank with potable water and tested for leakage for a minimum of 24 hours prior to system start-up and commissioning. Any leaks that are observed will be repaired and the tank re-tested.
- F. Contractor shall provide a drain for each piece of equipment, according to the OSHGS Supplier's instructions.
- G. Power shall be provided by the Contractor to the system control panels as shown on the OSHGS skid drawings. The Contractor shall be responsible for providing all necessary conduit and wiring necessary for a complete electrical service to this location. All wiring shall comply with the National Electrical Code.
- H. Installation shall include furnishing and applying an initial supply of lubricants, as provided by the OSHGS Supplier.
- I. Contractor shall support piping independent of equipment. Equipment shall be free from all loads and stresses induced by the piping.
- J. All equipment including motors, belts, and drives shall be aligned to the best industrial standards. Field check and adjust all equipment alignments in the presence of the Engineer.
- K. Tie-down lugs for tanks shall be grouted or shimmed to prevent excessive loads being transferred to the tank shell.
- L. Make all electrical connections in conformance with the requirements of the electrical specifications.

### 3.3 START-UP SERVICES AND FUNCTIONAL TESTING

- A. A factory technician from the OSHGS Supplier shall be present at the jobsite for initial system start-up/commission of equipment.
- B. Factory technician will ensure that the systems are properly installed, start-up the systems, and train the Owner's personnel.
- C. Contractor and OSHGS Supplier shall make equipment adjustments required to place system in proper operating condition.

### 3.4 IDENTIFICATION AND MARKING

- A. The OSHGS, along with all applicable components, shall be marked and identified for all health, flammability, and reactivity of hazardous materials as required by all applicable jurisdictional building codes, statues, standards, regulations, and laws.

**\*\* END OF SECTION \*\***

SECTION 11270  
BRINE TANK

1 GENERAL

1.1 SCOPE OF WORK

- A. This section covers the necessary work by the Contractor, On-Site Sodium Hypochlorite Generator System (OSHGS) Supplier, Owner and Engineer, to furnish, install, test, and make ready for operation brine storage tanks.

1.2 RELATED SECTIONS

- A. Onsite Sodium Hypochlorite Generation System – Section 11260
- B. All electrical, mechanical, metal, painting and instrumentation work included herein shall conform to the applicable Sections or Divisions of this project except as otherwise shown or specified.

1.3 QUALITY ASSURANCE

A. Brine Storage Tank Supplier Requirements

- 1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:
  - a. Assume full responsibility for the completeness and proper operation of the OSHG.
  - b. Have experience, be reputable, and be qualified in designing and manufacturing on-site hypochlorite generation equipment.
  - c. Have current NSF Standard 61 Certification for the tanks being offered.
  - d. Have at least 10 years' experience in manufacturing brine storage tanks.
  - e. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. Equipment footprint as shown on the drawings shall not be exceeded.
  - f. Have at least ten similar brine storage tanks in operation for at least five years.

B. Warranty

- 1. Prior to acceptance of the brine storage tank system, provide written warranty from the Supplier that includes the following statements:
  - a. Manufacturer and Supplier have inspected the installation during and after completion and the tanks are free from faults and defects and are in conformance with the Contract Documents.
  - b. The warranty period shall start from the date of commissioning of the system.
  - c. Principal components of the brine storage tanks will remain free of defects for a period of two (2) years from the date of final acceptance.

C. Product Submittals

- 1. The following product data shall be electronically submitted by the brine tank Supplier for review and approval by the Engineer that the product provided conforms to the site-specific requirements prior to the fabrication of the tanks:
  - a. Shop drawings and catalog literature showing dimensional information and details of piping, fabrication, and erection of all materials and equipment furnished under this section, including:
    - 1) Detailed drawings of tank nozzle orientations provided.
    - 2) Detailed drawings of equipment installations provided.
  - b. Scaled drawing of general layout, general arrangements, and major system components, including:



- 1) Dimensions, including those for system connections
  - c. Drawings showing fabrication, assembly, installation, and wiring diagram. Wiring diagrams for the electrical control panel and rectifier transformer shall consist of, at a minimum, control schematics, including coordination with other electrical devices operating in conjunction with the OSHGS.
  - d. Manufacturer's literature, illustrations including weight and dimensions, specifications, materials of construction, and bill of materials for each component of the system
  - e. Installation instructions.
  - f. Affidavits of compliance with referenced standards and codes.
- D. Operation and Maintenance Manuals
1. Detailed operation and maintenance (O&M) manuals shall be provided by the Supplier to the Engineer for review and approval. At a minimum, the following shall be included:
    - a. Required Operation Data.
      - 1) Complete, detailed operating instructions for each piece of equipment.
      - 2) Explanations for all safety considerations relating to operations.
      - 3) Recommended spare parts lists.
    - b. Required Maintenance Data.
      - 1) All information and instructions required by plant personnel to keep equipment properly cleaned, lubricated, and adjusted so that it functions economically throughout its full design life.
      - 2) Maintenance summary forms.
      - 3) Explanation with illustrations as necessary for each maintenance task
      - 4) Recommended schedule of maintenance tasks.
      - 5) List of maintenance tools and equipment.
      - 6) Name, address, and phone number of manufacturer and manufacturer's local service representative for major system components.
- E. Manufacturer Services
1. Prior to scheduling services by the Supplier, the Contractor shall verify the equipment installation and provide the completed installation checklist with photo documentation. Upon receipt of the completed installation checklist with photo documentation, the Supplier shall schedule start-up and training to take place no sooner than two (2) weeks. The Contractor shall coordinate testing requirements and scheduling with the Engineer.
  2. The Supplier shall be present at each jobsite for the following time period after the system is installed, travel time excluded:
    - a. Certification of proper installation, system startup, and functional testing.
      - 1) Installation inspection shall include supervising the correction of any defective or faulty work before acceptance by Owner.
      - 2) System startup shall include testing, calibrating, and adjustment of all components for optimum performance.
      - 3) Functional testing shall include inspection of integration of the provided equipment's controls to the Owner's SCADA system, etc.
    - b. Training Owner's personnel and providing detailed instructions in the operation, maintenance, and troubleshooting for the system.
      - 1) Upon request, a training manual will be provided with an outline of the training procedures.

- c. Services shall be provided by a technician that is factory-trained by the Supplier and has demonstrated ability and experience in the installation and operation of the equipment.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. The brine tanks shall be packaged and shipped so as not to incur damage to any portion of the equipment through handling and installation of the system itself.
- B. The Contractor shall be responsible for the delivery, storage, and handling of products in accordance with the Supplier's recommendations.
- C. The Owner shall inspect all equipment and materials against approved Shop Drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to the Supplier for replacement or repair.
- D. Equipment and materials shall be stored in a dry, chemical-free location and protected from the elements according to the Supplier's instructions.
- E. Equipment and materials shall be handled in an approved manner according to the Supplier's instructions.

## 2 PRODUCTS

### 2.1 BRINE STORAGE TANK

- A. A fiberglass-reinforced plastic (FRP) salt/brine storage tank shall be provided for the following operating conditions:
  - 1. Diameter: 10'-0"
  - 2. Wall Height: 15'-0"
  - 3. Salt Capacity: 42 Tons
- B. Design Criteria
  - 1. The brine tank vessel shall be designed for pressure service conditions as specified for Type I Grade 1 tanks in ASTM D 3299. Brine tank vessel shall conform to the following structural design criteria:
    - a. Working Pressure: Hydrostatic load of SG 1.2
    - b. Wind Load: 100 mph
    - c. Maximum Temperature: 140 °F
  - 2. A 10:1 safety factor shall be used for internal pressure loadings and a 5:1 safety factor shall be used for external and vacuum loadings.
- C. Quality Assurance
  - 1. Tanks shall be manufactured in an RTP-1 Accredited manufacturing facility.
  - 2. Visual defects shall be better than Level II on the inside of the vessel and better than Level III on the outside in accordance with ASTM D 2563 Table 1.
  - 3. The manufacturer shall have been regularly engaged in the design and manufacture of brine make-up and storage systems tanks such as specified herein for at least five years. The manufacturer's experience shall include at least fifteen installations of equal or larger capacity than specified herein, that have been in operation for at least five years.
- D. Materials and Construction
  - 1. The brine tank shall be vertical and consist of FRP vessel, salt fill line, water distribution system, outlet plenum, salt and brine level controls, and all internals. The brine tank shall be cylindrical with a flat bottom and domed top. Vessel size and configuration

shall be as shown on the drawings. Unit shall be complete with flanges, nozzles, manways, lifting lugs, anchor lugs, and other appurtenances.

2. The vessel shell shall be helically filament wound according to ASTM D-3299. Any shell fabrication by hand lay-up shall not be acceptable. Only the tank bottom and dome may be fabricated by hand lay-up. Any tank made of PVC, polypropylene, or any other material shall not be acceptable. Contact molded components and accessories, shall be fabricated in accordance with ASTM D 4097 and NBS PS 15-69. The resin used shall be a premium isophthalic polyester type such as AROPOL 7241 T-15 by Ashland Chemicals or approved equal. The resin will be exposed continuously to a saturated brine solution.
3. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste.
4. The laminate shall consist of a single resin rich layer, with either c-veil or Nexus 111-00010 reinforcement followed by two 1-1/2-ounce layers of -1/2-ounce layers of random chopped strand glass, fully wetted out with resin. This interior surface shall yield a minimum 100-mil thick corrosion barrier. Filament wind over this to the required thickness. Exterior surface coat shall be paraffinated. Vessels shall be surface coated on the exterior with gel coat containing ultra violet light such as UV-9. No thixotropic or other additives shall be used.
5. Other than those associated nozzles, couplings, manways, and top and bottom heads, the towers shall be filament wound in one piece with no more than one joint.
6. The minimum properties of filament wound laminate shall be as specified in ASTM D 3299.
7. 24" diameter manways shall be in accordance with ASTM D 3299. As a minimum, two manways (lower side, top) shall be provided for each tank. The top manway cover shall include over-pressurization relief protection.
8. Flanged nozzles, double flanged gusseted nozzles, bottom drain nozzle, and threaded full couplings shall be provided as required. Flanged nozzles with 1/8-inch thick EPDM full-face gaskets of 60 durometer shall be provided by the supplier. Press-molded flanges are not acceptable. Threaded full couplings shall be FRP.
9. The tank shall include salt fill connection, softener water connection, brine outlet connection, drain, overflow, salt level indicator, brine level indicator, and vent.
10. The minimum properties of contact molded laminate shall be as specified in ASTM D 4097.
11. Anchorage: Each tank shall be furnished with concrete anchors and hold down lugs, complete with 304 stainless steel plates, for proper anchoring of the tank as required by the design calculations. A minimum of four (4) hold down lugs shall be provided.
12. Unless otherwise specified, all fasteners, and metal attachments, such as anchors, brackets, etc. shall be ANSI 316SS.
13. Vessels designed for outdoor use shall have the bottom 6'-0" of straight shell insulated and heat traced for protection against freezing. Insulation shall be 2" thick polyurethane foam and be covered with a 1/8" thick FRP protective covering and receive a white pigmented gel coat with UV inhibitors. The top of the insulation will be capped to seal out any moisture. When adding heat tracing, calculate the heating load based on a 50-degree F delta, 20 mph wind if tanks are located outdoors, and insulated as specified above with a 10% safety factor. Heat tracing is to be installed by the manufacturer.

#### E. Accessories

1. The brine tank shall be provided with a full-radiused Sch 40 304 stainless steel salt fill line designed to receive salt pneumatically unloaded from a truck. Long-radius fittings

shall be used. One aluminum quick connect adapter and cover shall be provided to connect the truck's hose to the brine tank salt fill line as indicated on the drawings. One gooseneck vent shall be integrally molded into the brine tank dome. A vent dust collector bag shall be furnished and installed. The dust collector shall be properly sized for the salt fill rate and the brine tank capacity. The dust collector shall be polyester cloth material.

2. A water distribution system and a brine collection plenum shall be provided. Each assembly shall be securely installed in the brine/salt storage tank. Each assembly shall be designed to produce a saturated brine solution as required by the hypochlorite generators.
3. The brine tank shall be provided with a liquid level control assembly, including:
  - a. A pressure sensing-type electronic level transmitter.
  - b. Normally-closed, solenoid pilot-operated diaphragm valve shall have a brass body be ASCO 8210 Series. The solenoid valve shall open when brine solution level in the Brine Storage Tank is low. The solenoid valve shall close when the brine solution level in the Brine Storage Tank is high.
4. For tanks using granular or fine grade (less than 12 mesh) solar salt, a quartz rock filter bed shall be installed in the sump. The filter bed shall consist of a 5" layer of 0.125" x 0.125" on top of a 7" layer of 0.250" x 0.250". The filter bed shall be evenly-distributed over the entire bottom of the vessel. All quartz rock shall be AWWA-washed and NSF-certified.
5. The salt level sensor shall be a cable measurement transmitter. Cable measurement transmitter shall continuously measure salt level in the brine tank with 0.25% accuracy. Measuring cable length shall extend the entire height of the brine tank to measure salt at all levels. The cable shall be constructed of material resistant to saturated brine. Transmitter shall be Bin Master "Smart Bob II A.O." or equal.
6. A fiberglass-encapsulated nameplate shall be provided. At a minimum, the nameplate shall include the following information:
  - a. Project name
  - b. Installation location
  - c. Service
  - d. Specific gravity
  - e. pH
  - f. Pressure rating
  - g. Temperature rating
  - h. Resin
  - i. Size
  - j. Capacity
  - k. Shipping Weight
  - l. Date of manufacture
7. Unless otherwise specified, all pipe and fittings shall be Sch 80 PVC and all fasteners stainless steel.

## 2.2 BRINE FILTERS

- A. A wall-mounted cartridge type filter housings holding a 10" cartridge for dirt, rust, and particulate matter from the brine stream shall be provided. The filter housing shall be feature NPT inlet and outlet connections and mounting bracket that must be non-metallic construction. A polypropylene cap with Buna-N O-ring shall be supplied.
- B. The filter cartridge shall be a 50-micron, disposable cartridge.

### 3 EXECUTION

#### 3.1 INSTALLATION

- A. Installation of the tanks and appurtenances shall be performed by the Contractor and shall be in accordance with the Drawings and with the Supplier's instructions and recommendations. Conflicts of information shall be called to the attention of the Engineer. It is the Contractor's responsibility to provide:
1. Water piping and valves from source to water softener, if applicable, and from softener to brine tank and electrolytic cell skid.
  2. Brine piping and valve from brine tank to electrolytic cell skid.
  3. All overflow and drain piping and valves.
  4. Electrical connections, wiring, and conduits to/from system control panel for power, control, and alarm interfaces with remote located instruments (tank level and pressure transmitters, etc.), plant SCADA, etc.
    - a. All wiring to be TTHN stranded wiring and will conform to the most current version of the National Electric Code.
    - b. All 4-20 mA instrumentation wiring will be 2- or 4-conductor shielded cable.
    - c. Instrumentation and signal/control wiring will be run in conduits separated from all other AC wiring systems.
  5. Any necessary unistrut, hangers, supports, etc. for Contractor-supplied piping and conduits.
  6. Anchor bolts, suitable concrete mounting pads and other incidentals as necessary to complete the installation.
  7. Pressure testing of all interconnecting piping as is practical or directed by the Owner.
  8. Flushing of all piping with potable water prior to system start-up and commissioning to remove materials that may have entered as a result of the installation process.
- B. All equipment units or assemblies shall be installed on concrete bases and secured with anchor bolts in accordance with the Supplier's recommendations and as shown. The contractor shall coordinate with supplier for skid placement and anchoring.
- C. Contractor shall inspect all concrete pads for proper elevation, dimensions, cutouts, evenness and anchor bolt locations and correct if necessary.
- D. The Contractor shall inspect all equipment before installation, if damaged; notify the Engineer and Supplier promptly. Do not install damaged equipment until the Supplier makes repairs in accordance with Supplier's written instruction and approval.
- E. The Contractor shall, after installation of tanks is complete but before piping connections are made, block all outlets and fill each tank with potable water and tested for leakage for a minimum of 24 hours prior to system start-up and commissioning. Any leaks that are observed will be repaired and the tank re-tested.
- F. Contractor shall provide a drain for each piece of equipment, according to the Supplier's instructions.
- G. Contractor shall support piping independent of tanks. Tanks shall be free from all loads and stresses induced by the piping.
- H. Tie-down lugs for tanks shall be grouted or shimmed to prevent excessive loads being transferred to the tank shell.
- I. Make all electrical connections in conformance with the requirements of the electrical specifications.

#### 3.2 START-UP SERVICES AND FUNCTIONAL TESTING

- A. A factory technician from the Supplier shall be present at the jobsite for initial system start-up/commission of equipment.

- B. Factory technician will ensure that the systems are properly installed, start-up the systems, and train the Owner's personnel.
- C. Contractor and Supplier shall make equipment adjustments required to place system in proper operating condition.

### 3.3 IDENTIFICATION AND MARKING

- A. The tanks, along with all applicable components, shall be marked and identified for all health, flammability, and reactivity of hazardous materials as required by all applicable jurisdictional building codes, statues, standards, regulations, and laws.

**\*\* END OF SECTION \*\***

SECTION 15064  
POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pipe and fittings as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. Use only pipe and fittings manufactured in the USA.
- B. All pipe shall be tested and inspected at the place of manufacture for all requirements of the latest ASTM and Commercial Standard tests and certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
  - 1. Nominal size
  - 2. Type and grade of material and ASTM standard
  - 3. SDR, class, or schedule rating
  - 4. Manufacturer
  - 5. ANSI/NSF seal of approval

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Shop Drawings, Product Data, and Samples.

1.4 STORAGE AND PROTECTION

- A. PVC pipe and fitting shall be stored and protected in accordance with the requirements of the manufacturer, this section, and Section 01620, Product Storage and Handling Requirements.
- B. Protect pipe and fittings stored outdoors from direct exposure to sunlight. Covers must be non-transparent and covering must provide adequate air circulation above and around the pipe to prevent excessive heat absorption.
- C. Store pipe on level ground in the unit packages provided by the manufacturer.
- D. Do not stack pipe more than 8 feet high.
- E. When stacking pipe, make sure the weight of the upper pipe units does not cause deformation of the lower pipe units. Stack palletized pipe wood on wood.
- F. Do not store pipe in tightly enclosed areas subject to elevated temperatures or close to heat producing sources.
- G. Do not drop pipe, drop objects on pipe, or subject pipe to external loads.
- H. Do not drag pipe across the ground or over obstacles.
- I. Remove pipe or fittings found with any scratches, splits, or gouges from the job site.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, Warranties.

## 2 PRODUCTS

### 2.1 MATERIALS

- A. Schedule 80 Polyvinyl Chloride (PVC) Pipe
  - 1. PVC Material: Type 1, Grade 1 with Cell Classification 12454 per ASTM D1784
  - 2. Construction: Iron pipe size per ASTM D1785
  - 3. Maximum Service Temperature: 140 °F
  - 4. Color: Dark Gray
- B. Schedule 80 Chlorinated Polyvinyl Chloride (CPVC) Pipe
  - 1. PVC Material: Type 4, Grade 1 with Cell Classification 23447 per ASTM D1784
  - 2. Construction: Iron pipe size per ASTM F441
  - 3. Maximum Service Temperature: 200 °F
  - 4. Color: Light Gray
- C. Schedule 80 Polyvinyl Chloride (PVC) Fittings
  - 1. PVC Material: Type 1, Grade 1 with Cell Classification 12454 per ASTM D1784
  - 2. Construction: Per ASTM D2467
  - 3. Maximum Service Temperature: 140 °F
  - 4. Color: Dark Gray
- D. Schedule 80 Chlorinated Polyvinyl Chloride (CPVC) Fittings
  - 1. PVC Material: Type 4, Grade 1 with Cell Classification 23447 per ASTM D1784
  - 2. Construction: Per ASTM F439
  - 3. Maximum Service Temperature: 200 °F
  - 4. Color: Light Gray
- E. Primer
  - 1. Conform to ASTM F656
- F. Solvent Cement
  - 1. PVC: Conform to ASTM D2564
  - 2. CPVC: Conform to ASTM F493

## 3 EXECUTION

### 3.1 INSTALLATION

- A. Cutting
  - 1. Make square and smooth cuts using cutting tools that are designed for use on plastic pipe.
  - 2. Remove burrs from outside and inside of pipe.
  - 3. Place a 10° to 15° bevel approximately 1/16" to 3/32" in width on the end of the pipe.
- B. Solvent Cementing
  - 1. Clean pipe, fittings, and tools so they are free of dirt, moisture, grease, and other contaminants.
  - 2. Condition pipe, fittings, and accessories to same temperature conditions prior to use.
  - 3. Measure socket depth and mark on pipe as a reference mark to ensure pipe is completely bottomed into fitting during assembly.
  - 4. Apply primer to fitting/accessory socket and to pipe end.



5. Apply solvent cement to fitting/accessory socket and to pipe end while primer is still tacky.
6. While both surfaces are still wet with solvent cement, immediately insert the pipe fully into the fitting socket while rotating the pipe ¼ turn. Hold assembly for approximately 30 seconds to ensure initial bonding.
7. Allow solvent cemented assembly to set for 1 to 5 minutes, depending on pipe size and temperature, without any stress on the joint.

C. Buried Pipe Installation

1. PVC and CPVC pipe for underground pressure applications shall be installed in accordance with AWWA C605 with Type 5 embedment.
2. Minimum Depth of Cover: 3-feet
3. Maximum Depth of Cover: 14-feet.

D. Above Ground Installation

1. Support PVC and CPVC pipe and fittings using appropriate pipe supports as specified in Section 15094, Hangers and Supports for Plumbing and Equipment.
2. PVC and CPVC pipe shall be supported and maximum intervals recommended by the pipe manufacturer; however, the pipe support spacing shall not exceed the distances shown in the following tables.

<b>PVC Pipe Support Spacing (feet)</b>		
<b>Pipe Size (inches)</b>	<b>Schedule 40</b>	<b>Schedule 80</b>
¼	2	2
3/8	2	2.5
½	2.5	2.5
¾	2.5	2.5
1	2.5	3
1¼	3	3
1½	3	3.5
2	3	3.5
2½	3.5	4
3	3.5	4
3½	4	4.5
4	4	4.5
6	4.5	5
8	4.5	5.5
10	5	6
12	5.5	6.5
14	6	7
16	6.5	7.5
18	7	9
20	8.5	9.5
24	9.5	10.5

<b>CPVC Pipe Support Spacing (feet)</b>		
<b>Pipe Size (inches)</b>	<b>Schedule 40</b>	<b>Schedule 80</b>
¼	2.5	2.5
3/8	2.5	2.5
½	2.5	2.5
¾	2.5	2.5
1	2.5	3

CPVC Pipe Support Spacing (feet)		
Pipe Size (inches)	Schedule 40	Schedule 80
1¼	3	3
1½	3	3.5
2	3	3.5
2½	3.5	4
3	3.5	4
3½	4	4.5
4	4	4.5
6	4.5	5
8	5	5.5
10	5.5	6
12	6	6.5
14	6	8
16	7	8.5
18	7.5	9
20	7.5	9.5
24	8	10

3. Paint all exposed pipe as specified in Section 09900, Painting.
4. Outdoor Applications
  - a. Protect all pipe installed above ground and outside from freezing using insulation and heat trace tape.

### 3.2 FIELD TESTING PIPE

- A. All pressure tests must be witnessed by Engineer.
- B. **DO NOT** pressure test piping assembly with air or compressed gas.
- C. Pressure test piping assembly with water.
- D. All solvent cemented connections must be fully cured prior to pressure testing.
- E. Piping assembly must be adequately anchored/restrained prior to pressure testing.
- F. Pressure test piping assembly to 200% of maximum working pressure or to the maximum working pressure of the lowest pressure rated component in the system, whichever is less.
- G. Test Procedure
  1. Slowly fill system with water, venting air from valves at piping run ends and at elevations during the filling process.
  2. Any slow buildup of gauge pressure or any fluctuating gauge needle on a completely liquid filled system is a strong indication that entrapped air is present in the system. In this case, immediately release pressure and re-bleed line.
  3. Pressurize system to test pressure using hydraulic hand pump or water supply line, if pressure is sufficient.
  4. System must hold pressure for a minimum of 2-hours to demonstrate system integrity.
  5. If leak is found or pressure is not maintained, relieve remaining pressure, cut-out failed sections, replace, and allow time to cure properly prior to retesting.

\*\* END OF SECTION \*\*

SECTION 15094  
PIPE SUPPORTS AND HANGERS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes providing all pipe supports, hangers, and brackets necessary to install piping furnished under these Contract Documents. The Contractor shall furnish and install all foundations, anchor bolts, pipe supports, shims, hangers, clamps, and hardware required for a complete installation as shown on the Drawings and/or specified herein.
- B. For clarity, not all pipe supports are shown on the drawings. All pipes shall be supported in accordance with these specifications. All valves and changes in pipe direction shall be supported by concrete pier or mechanical type pipe support.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Submittals.

1.3 STORAGE AND PROTECTION

- A. Pipe supports and accessories shall be stored and protected in accordance with the requirements of Section 01620, Storage and Protection.

1.4 SHOP PAINTING

- A. Fabricated pipe supports and accessories, except where shown on the Drawings to be galvanized, shall be cleaned and shop primed in accordance with requirements of Section 09900, Painting.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with requirements of Section 01740, Warranties and Bonds.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Anvil International
- B. Cooper B-line
- C. Or equal

2.2 MATERIALS

- A. All supports and hangers shall meet the following material requirements:
  - 1. All structural carbon steel shall conform to ASTM A36.
  - 2. All 304L/316L stainless steel shall conform to ASTM A276
  - 3. All pipe support columns shall conform to ASTM A53, Grade B, and shall be minimum Schedule 40.
  - 4. Pipe supports shall be adjustable.
  - 5. Threaded rods and U-Bolts shall be type 316 stainless steel.
  - 6. All hardware shall be type 316 stainless steel.

3 EXECUTION

3.1 GENERAL

- A. Long runs of pipe subject to expansion shall be hung by means of adjustable swivel pipe roll hangers.
- B. Short runs of uninsulated pipe subject to expansion in sizes up to and including 3½ inches, as well as, all pipe of those sizes **not** subject to expansion shall be hung by means of adjustable swivel, split pipe ring.
- C. Insulated piping and tubing, short lengths of 4 inches and larger pipe subject to expansion, and pipe 4 inches and larger **not** subject to expansion shall be hung by means of adjustable steel clevis hangers.
- D. Pipe 2 inches and less in diameter and not subject to expansion may, when paralleling walls, be supported by single hook clamp hangers.
- E. Flat strap hangers will not be permitted. Hangers relying on mastics or adhesives shall not be used.
- F. Pipe supported from underneath and subject to expansion shall have adjustable pipe roll stand supports. The pipe roll stand shall be supported by concrete piers, structural steel, or steel brackets as required.
- G. Pipe supported from underneath and not subject to expansion shall have cast-in-place concrete supports or adjustable pipe saddle supports on properly sized pipe stanchions and ample, properly grouted floor flanges.
- H. Hangers suspended from structural steel shall be supported on U.F.S. beam clamp with links as required.
- I. Hangers from concrete work shall be secured by universal, galvanized metal inserts placed in the concrete at the time of pouring. Wooden plugs or other improvised means shall not be used for any form of hanger fastening.
- J. All interior and exterior concrete piers shall be Class A concrete meeting the requirements of these Specifications.
- K. Rods for supporting suction bells or foot valves of pump intakes shall be stainless steel. The rods shall be furnished complete with stainless steel turnbuckles and eyes or other approved means for connection to the suction bell and stainless steel eye bolt anchored in the concrete. Supports for other pump suction pipelines shall be as shown on the Drawings.
- L. Uninsulated copper tubing shall be hung by means of copper-plated, split ring hangers with copper-plated sockets.

### 3.2 INSTALLATION

- A. Contact between ferrous supports and non-ferrous piping materials shall not be permitted. Supports and clamps shall be rubber coated or copper plated as necessary to prevent this condition.
- B. Adequate supports shall be provided so that there is no movement or visible sagging between supports.
- C. Hangers shall permit a minimum of 1½-inch vertical adjustment after installation.
- D. Hanger rods shall be carbon steel conforming to the following sizes:

Rod Diameter (Inch)	Pipe Size (Inch)
½ and under	¼ - 2
¾	2½ - 4
5/8	5 - 8
7/8	10 and up

- E. Carbon steel, alloy steel, stainless steel, and hard-drawn copper pipe shall have maximum support intervals as recommended by pipe manufacturer; however, support intervals shall not exceed the intervals shown in the following tables:

**Maximum Interval for Steel, Feet**

<b>Pipe Size, In.</b>	<b>Liquid</b>	<b>Gas</b>	<b>Maximum Interval for Copper, Feet</b>
1/2	5	6	4
3/4	6	7	5
1	7	9	6
1 1/2	9	11	8
2	10	13	8
2 1/2	11	14	9
3	12	15	10
4	13	17	11
6	17	21	-
8	19	24	-
10	22	27	-
12	23	29	-
14	25	32	-
16	27	35	-
18	28	37	-
20	30	39	-
24	32	42	-

- F. Annealed copper tubing, polyethylene tubing, and PVC piping shall be supported on maximum intervals as follows:

<b>Tube Size, In.</b>	<b>Maximum Interval, Ft.</b>
3/8 and smaller	2
1/2 - 1	2.5
1 1/4 - 2	3
2 1/2 - 3	3.5
3 1/2 - 4	4
6-8	4.5

- G. Where indicated or directed by the Engineer, exposed piping and tubing carrying liquid shall be sloped as necessary to permit complete draining. Pipe deflection between supports shall be considered when determining the slope required to permit complete drainage. All underground piping shall be sloped uniformly for complete drainage.
- H. Cast iron or ductile iron piping shall be supported as recommended by the manufacturer, and at all valves and fittings larger than 4 inches in size. At least one support shall be provided per pipe section or at every other joint, whichever is closer. Supports shall be located next to hubs or bells.
- I. Open ends of pipe columns used for support shall be completely covered with a 1/4-inch-thick plate or angle leg welded in place.
- J. All threaded connections installed loose, such as hanger rods and U-bolts, shall have a double nut installation.
- K. Vertical piping shall be supported as shown or required to prevent buckling or swaying utilizing special brackets. Unless otherwise shown, vertical piping shall be supported at the bottom and at each floor. Vertical copper tubing 1 inch and smaller in size shall be supported at 5-foot intervals.
- L. Provide a support within 18 inches of each elbow and within 24 inches of each equipment connection.
- M. Pipes passing through non-load bearing walls and partitions shall not bear on building construction. Pipes shall not be supported from roof decking, bar joists, or ceiling suspension systems unless approved by the Engineer.

- N. Insulation on hot piping (carrying fluids above 70°F) shall be protected at supports and hangers with a 12-inch long galvanized steel protection saddle with welded center support. Protection saddle shall be Grinnell Figure 160 or 161, Fee and Mason Figure 171 or 1710, or equal.
- O. Insulation on cold piping (carrying fluids at 70°F or below) shall be protected at supports and hangers by galvanized steel insulation shields with a 180-degree contour. Insulation shields shall be Grinnell Figure 167, Fee and Mason Figure 81, or equal.
- P. On insulation finished with an aluminum jacket, a 1/32-inch thick sheet of neoprene shall be provided between the jacket and the shield.
- Q. Hangers shall be selected to fit around insulation.
- R. Following installation all pipe supports shall be field primed and painted with the specified painting system for the application in accordance with requirements of the section titled "Painting" of these Specifications.
- S. Unless otherwise shown, piping shall not be fastened to a support in such a manner that would prevent axial movement due to thermal expansion and contraction.
- T. No pipe supports shall be anchored to or supported from floor grating.
- U. Unless otherwise noted, piping dimensions shown on the Drawings are for reference only and shall be verified in the field by the Contractor. The Contractor shall size supports and hangers using actual field dimensions.

\*\* END OF SECTION \*\*

SECTION 15095  
WATER UTILITY DISTRIBUTION PIPING AND VALVES

1 GENERAL

1.1 DESCRIPTION

- A. Provide and water distribution piping and miscellaneous piping appurtenances as indicated and specified. Sizes and capacities indicated or specified.

1.2 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
1. Manufacturer's specifications, catalog data, descriptive matter, illustrations, certified shop drawings, wiring and diagrams.
  2. Data regarding valve characteristics and performance.
  3. Shop drawing data for accessory items.
  4. Manufacturer's literature as needed to supplement data.
  5. Operating and maintenance manuals in accordance with Section 01730.
  6. Recommended spare parts other than those specified.

2 PRODUCTS

2.1 PVC PIPE

- A. See Specification Section 15064, Polyvinyl Chloride Pipe (PVC) and Fittings. .

2.2 COPPER TUBING

1. ASTM B88, Type K, annealed.
2. Fittings: ASME B16, cast copper or ASME B16.22, wrought copper.
3. Joints: Compression connection or AWS A5.8, BCuP silver braze

2.3 VALVES

A. Ball Valves:

1. PVC Ball Valves
  - a. True Union Ball Valves
  - b. Body Material: PVC Cell Class 12454 per ASTM D1784
  - c. Full port design
  - d. Reversible PTFE seats
  - e. End Connections: True Union SOC x True Union SOC
  - f. Seals: FPM
  - g. Ball Valves used for sodium hypochlorite service shall be vented type.
  - h. Pressure Rating
    - 1) ½" to 2" Valves: 250 PSI @ 70°F Non-Shock
    - 2) 2½" to 4" Valves: 235 PSI @ 70°F Non-Shock
  - i. Manufacturers
    - 1) Hayward Industries, Inc.
    - 2) Engineer approved equal.

2.4 CORPORATION STOPS

- A. Manufacturers:
-

1. Hayes Mfg. Co., Gastonia, NC, Model 5200.
2. Clow Corporation, Chicago, IL.
3. Mueller Co., Decatur, IL.
4. Or approved equal.

B. Materials: ASTM B62 bronze with a lapped, ground key.

C. Inlet thread of steep taper type. Outlet connections to suit type of pipe or tubing connected.

## 2.5 SHOP PAINTING

A. Shop apply to all ferrous surfaces, except stainless steel, a high solids epoxy coating.

B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions.

C. Ferrous surfaces obviously not to be painted shall be given a shop applied coat of grease or rust resistant coating.

## 2.6 BACKFLOW PREVENTERS

A. Double Check Valve Backflow Preventer

1. Consists of two positive seating, replaceable check modules with captured springs and replaceable rubber seat discs.
2. Make all internal components serviceable through a single bronze or stainless steel access cover with stainless steel bolts.
3. Provide two resilient seated isolation valves and four top mounted resilient seated test cocks.
4. Meet requirements of ASSE 1015 and AWWA C510.

B. RPZ Backflow Preventer

1. Consists of an internal pressure differential relief valve located between two positive seating, replaceable check modules with captured springs and replaceable silicone seat discs.
2. Make all internal components serviceable through a single bronze or stainless-steel access cover with stainless steel bolts.
3. Provide two resilient seated isolation valves, four resilient seated test cocks, and an air gap drain fitting.
4. Meet requirements of ASSE 1013 and AWWA C511.

## 2.7 WATER FOR TESTING

A. The CONTRACTOR shall furnish all equipment, piping and required labor to transport water from an existing hydrant or designated tank on-site to the test location for use in testing. The OWNER will provide the water required for testing the Work from a fire hydrant as directed by the OWNER. Contractor shall provide a fire hydrant meter to measure water usage.

## 2.8 TEST EQUIPMENT

A. The CONTRACTOR shall provide all labor and equipment, including required pumps with regulated bypass meters and gauges, for conducting tests.

# 3 EXECUTION

## 3.1 GENERAL

A. Water Utility Distribution Piping and Misc. Pipe

1. Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, and vandalism.



2. Clean debris, dirt, and gravel, from inside of piping before placing valves in place.
  3. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation.
  4. Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on wall pipes vertically and grout in place. Locate valves in control piping for easy access.
  5. Provide sleeve type coupling or flexible type grooved coupling on downstream side of buried valves to assist in valve removal.
  6. Provide valves with pinned extension stems for convenience of operation. Provide extension stems for valves installed underground and elsewhere so that operating wrench does not exceed 6 feet in length
  7. Supply all necessary safety and protection methods as required by State, local, and OSHA standards and codes.
  8. Provide dewatering as required to keep trench and excavation dry during construction.
- B. Testing of Pressure Pipelines
1. The entire length of all pressurized pipelines shall be field tested for tightness by a test as described hereinafter.
  2. The CONTRACTOR shall furnish all labor and equipment, including required pumps with regulated bypass meters and gauges, for conducting pipeline tests.
  3. The CONTRACTOR shall furnish all equipment, piping and required labor to transport water from its source to the test location for use in testing
  4. Timing and sequence of testing shall be scheduled by the CONTRACTOR, subject to the approval of the ENGINEER. The CONTRACTOR shall provide the ENGINEER with a minimum of 24-hours' notice prior to the start of any test. All tests must be observed by the ENGINEER
  5. The CONTRACTOR shall repair any leaks discovered during the initial filling of the pipeline and during the testing sequence. All known and visible leaks shall be repaired whether or not the leakage rate is within allowable limits

### 3.2 INSTALLATION – PIPE

- A. Maintain separation of water main from sewer piping in accordance with State and local code.
- B. Install pipe to indicated elevation to within tolerance of 1-inch.
- C. Install ductile iron piping and fittings to AWWA C600.
- D. Install grooved and shouldered pipe joints to AWWA C606.
- E. Route pipe in straight line.
- F. Install pipe to allow for expansion and contraction without stressing pipe or joints.

### 3.3 INSTALLATION – VALVES

- A. Set valves on solid bearing.
- B. Provide valve box for each buried stop and valve.
- C. Center and plumb valve box over valve and does not bear on valve, stop or pipe. Set valve box flush with finished grade and install concrete collar.

### 3.4 INSTALLATION – BACKFLOW PREVENTERS

- A. Double Check Valve Backflow Preventer
  1. Install backflow preventer in a meter box with a lid. Provide a minimum clearance of 8 inches. Place crushed stone at the bottom of the box.

2. Install heat tracing on the backflow preventer.
  3. Locate the backflow preventer at the water meter
- B. RPZ Backflow Preventer
1. Install backflow preventer above ground over a concrete pad with a Hot Box enclosure.
- C. Obtain the services of a County approved backflow preventer testing firm to verify the operation of the backflow preventer. Submit the certificate of testing to the Owner for final acceptance.

### 3.5 TEST PROCEDURES FOR PRESSURE PIPELINES

A. General:

1. All pipelines shall be pressure tested in accordance with the specifications following for each type of service.
2. All meters, fixtures, devices or applications which are connected to the pipeline system and which might be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped during the test procedures. Items that are damaged during the testing procedure shall be repaired or replaced by the CONTRACTOR at no expense to the OWNER.
3. Where any section of a pipeline is provided with concrete reaction blocking, the pressure test shall not be made until at least five days have elapsed after installation of the blocking.
4. Clean and test lines before requesting final acceptance. Where any obstruction is met, clean the lines by means of rods, swabs, or other instruments. When requested by the ENGINEER, flush out lines and manholes before final inspection.

B. Pressure Piping:

1. All sections of pipeline subject to internal pressure shall be pressure tested in accordance with AWWA C600. A section of line will be considered ready for testing after completion of all thrust restraint and backfilling, subject to curing of concrete blocking as specified herein.
2. Test Preparation:
  - a. Flush pipeline section thoroughly at flow velocities greater than 2.5 feet per second, to remove debris from pipe and valve seats. Partially operate valves and hydrants to clean out seats. Provide correctly sized temporary outlets in number adequate to achieve flushing velocities.
  - b. Provide temporary blocking, bulkheads, flanges and plugs to assure all new pipe, valves and appurtenances will be pressure tested.
  - c. Applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Unless permanent air vents are in place, insert temporary corporation stops at highpoints to expel air as line is filled with water.
  - d. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure. Differential pressure at valves and hydrants shall equal the maximum possible but shall not exceed manufacturer's pressure rating. Provide temporary back pressure to meet the differential pressure restrictions.
  - e. Valves and hydrants shall not be operated in either the opening or closing direction at differential pressures above their rated pressure.
3. The test pressure shall be applied to the lowest point in the test segment and shall be maintained for a minimum of two hours.
4. The test pressure shall not vary by more than 5 psi for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be

restored to the specified test pressure. Provide an accurate pressure gauge with graduation not less than 5 psi.

5. Leakage: Leakage shall be defined as the quantity of water that must be pumped into the test section equal to the sum of the water, to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
6. Test Results: No test section of steel or ductile-iron pipe shall be accepted if the leakage exceeds the limits determined under Section 4 of AWWA C600. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results. Allowable leakage in PVC pipe, if used on the project, shall be 11.65 gallons per inch of nominal diameter per mile over a 24-hour period.
7. Completion: After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.

C. Miscellaneous Pressure Piping:

1. Upon completion of each piping system or sub-system, blow the lines free of dirt and debris and test in the presence of the ENGINEER. Wherever possible, test before the trench is backfilled. Drain piping shall be tested prior to encasement in concrete. The minimum test duration shall be one hour. The pipeline shall fail the test if a measurable pressure drop is observed.

3.6 REPAIRS - PIPELINES

- A. If the leakage exceeds the specified allowable limits, the point or points of leakage shall be sought out and remedied by the CONTRACTOR at no additional cost to the OWNER. Repair methods must be approved by the ENGINEER.

3.7 CLEANUP

- A. After completing each section of the pipeline, the CONTRACTOR shall remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line and leave the entire right-of-way in a clean, neat, and serviceable condition.

3.8 FINAL ACCEPTANCE

- A. No pipeline installation or hydraulic structure shall be accepted until compliance with allowable leakage limits.
- B. The CONTRACTOR will certify that all required tests have been successfully completed before the work is accepted.

**\*\* END OF SECTION \*\***