

\*\*\*\*\*  
IFB NO. Y15-743-PH ISSUED: December 17, 2014

INVITATION FOR BIDS  
FOR  
EASTERN WATER RECLAMATION FACILITY GENERATOR CONVERSION AND  
HYPOCHLORITE STORAGE IMPROVEMENTS

\*\*\*\*\*

PART H  
TECHNICAL SPECIFICATIONS

\*\*\*\*\*

PART H Volume III

.....

**Technical Specifications – Issued for Bid**

**Eastern Water Reclamation Facility  
Hypochlorite Storage Improvements**

**Orange County Utilities Contract #:Y11-902B  
Reiss Engineering, Inc. Project #: 110004**

**October 2014**

**Prepared For:**



**Orange County Utilities  
Engineering Division  
9150 Curry Ford Road  
Orlando, FL 32825**



**ORANGE COUNTY UTILITIES  
HYPOCHLORITE STORAGE IMPROVEMENTS  
Technical Specifications**

**Table of Contents**

---

- 1. Master Bid Item Schedule**
- 2. Technical Specifications**

**DIVISION 01 - GENERAL REQUIREMENTS**

<u>Section</u>	<u>Title</u>
01000	General Requirements
01010	Summary of Project
01014	Sequence of Construction
01025	Measurement and Payment
01027	Applications for Payment
01041	Project Coordination
01050	Field Engineering
01065	Permits and Fees
01070	Abbreviations and Symbols
01100	Special Project Procedures
01200	Project Meetings
01310	Construction Progress Schedules
01340	Submittals
01370	Schedule of Values
01380	Construction Photographs
01410	Testing and Testing Laboratory Services
01500	Temporary Facilities
01505	Mobilization
01580	Project Identification and Signs
01600	Material and Equipment
01650	Start-Up and Demonstration
01700	Contract Closeout
01710	Cleaning
01720	Project Record Documents and Survey
01730	Operating and Maintenance Data
01740	Warranties and Bonds
01800	Miscellaneous Work and Cleanup

## **DIVISION 02 – SITE CONSTRUCTION**

<u>Section</u>	<u>Title</u>
02230	Site Preparation
02240	Dewatering
02310	Finish Grading
02315	Excavation and Fill
02320	Trenching, Bedding and Backfilling
02370	Erosion and Sedimentation Control
02485	Sodding

## **DIVISION 03 - CONCRETE**

03100	Concrete Formwork
03150	Modifications and Repair to Concrete
03200	Concrete Reinforcement
03250	Concrete Joint and Joint Accessories
03300	Cast-in-Place Concrete
03350	Concrete Finishing
03600	Grout

## **DIVISION 04 – MASONRY (NOT USED)**

## **DIVISION 5 – METALS (NOT USED)**

## **DIVISION 06 – WOOD AND PLASTICS**

<u>Section</u>	<u>Title</u>
06615	Fiberglass Reinforced Plastic Components

## **DIVISION 07 – THERMAL AND MOISTURE PROTECTION (NOT USED)**

## **DIVISION 8 – DOORS AND WINDOWS (NOT USED)**

## **DIVISION 9 - FINISHES**

<u>Section</u>	<u>Title</u>
09900	Painting and Coating of Process Equipment
09905	Piping, Valve, and Equipment Identification System

**DIVISION 10 – SPECIALTIES (NOT USED)**

**DIVISION 11 - EQUIPMENT**

11345 Sodium Hypochlorite Feed System

**DIVISION 12 – FURNISHINGS (NOT USED)**

**DIVISION 13 – SPECIAL CONSTRUCTION**

<u>Section</u>	<u>Title</u>
13209	Polyethylene Storage Tanks
13300	Process Instrumentation and Control System
13591	Network Cable

**DIVISION 14 – CONVEYING SYSTEMS (NOT USED)**

**DIVISION 15 - MECHANICAL**

<u>Section</u>	<u>Title</u>
15000	General Mechanical Requirements
15044	Pressure Testing of Piping
15062	Ductile Iron Pipe and Fittings
15065	Underground Piping and Fittings
15070	Polyvinyl Chloride (PVC) Pipe and Fittings
15100	Valves and Appurtenances
15126	Pipe Hangers and Supports

**DIVISION 16 - ELECTRICAL**

<u>Section</u>	<u>Title</u>
16010	Basic Electrical Requirements
16100	Raceways, Boxes and Cabinets
16120	Wires and Cables
16160	Panelboards
16195	Electrical Identification
16450	Grounding System
16500	Lighting System
16709	Surge Protection Devices (SPD)

## **APPENDICES**

### Appendix A Geotechnical Report

### Appendix B Forms

- Pressure Test
- Water Main Disinfection Certification

### Appendix C Permits Obtained By The County

- FDEP Courtesy Notifications
- FDEP Environmental Research Permit (submitted by others, AECOM)
- Orange County Building Permit
- Orange County Concurrency Deminimis

### Appendix D List of Approved Products

- Orange County Utilities – List of Approved Products (February 11, 2011)

**BID SCHEDULE**

**ORANGE COUNTY EWRF HYPOCHLORITE STORAGE IMPROVEMENTS PROJECT**

**OCU File No. 07126**

**CAP No. 1538-09**

Bidder is to understand that the total bid price is based on the estimated quantities and will control in awarding the Contract as provided in the Instructions to the Bidder. It is further understood that the quantities stated in the Bid Schedule for various items are estimated only and may be increased or decreased as provided in the Contract.

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
1	Mobilization, Demobilization, Bonds and Permits (10%)	1	LS		
2	All other work under this Contract.	1	LS		

Summation of Subtotals for All Items:

TOTAL ESTIMATED BID AMOUNT \$ \_\_\_\_\_



Orange County Utilities  
Hypochlorite Storage Improvements  
Issued for Bid  
October 2014

**SECTION 01000  
GENERAL REQUIREMENTS**

**PART 1 - GENERAL**

1.01 SCOPE AND INTENT

A. Description:

1.02 This Contract is for the construction of the Orange County Hypochlorite Storage Improvements Project consists of mechanical, electrical and instrumentation and control improvements associated with the installation of three new 7,300-gallon single-wall, vertical polyethylene storage tanks under a new metal roofed structure, fire sprinklers, and with a concrete containment area. New PVC single-wall feed piping will be installed from metering pump skids at the new hypochlorite storage area to the dosing points at Phase II and Phase III injection locations, as well as provisions to accommodate the Phase V improvements including Phase V pump skid. Piping from the Phase V skid will be stubbed and capped allowing the building to remain undisturbed during the future construction. The proposed PLC will communicate with the SCADA via fiber optic cable, which will run to the existing fiber patch panel located at the shed located east of the existing outdoor sodium hypochlorite storage tanks. The fiber will be extended by others to the Phase V West Electric Building during Phase V as shown on the Drawings and specified herein.

A. Work Included:

1. The Contractor shall furnish all supervision, labor, materials, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and means of construction necessary for proper performance and completion the work. He shall obtain and pay for all required permits. He shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the Owner, and in strict accordance with the Contract Documents. The Contractor shall clean up the work and maintain it during and after construction, until accepted, and shall do all work and pay all costs incidental thereto. He shall repair or restore all structures and property that may be damaged or disturbed during performance of the work.
2. The cost of incidental work described in these General Requirements, for which there are no specific Contract Items, shall be considered as part of the general cost of doing the work and shall be included in the prices for the various Contract Items. No additional payment will be made therefore.
3. The Contractor shall provide and maintain such modern materials, tools, and equipment as may be necessary, in the opinion of the Engineer, to perform in a satisfactory and acceptable manner all the work required by this Contract. Only equipment of established reputation and proven efficiency shall be used.

The Contractor shall be solely responsible for the adequacy of his workmanship, materials and equipment, prior approval of the Engineer notwithstanding.

B. Public Utility Installations and Structures:

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, vaults, manholes and all other appurtenances and facilities pertaining thereto whether owned or controlled by the Owner, other governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage, water or other public or private property which may be affected by the work shall be deemed included hereunder.
2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make his own investigations to inform himself fully of the character, condition and extent of all such installations and structures as may be encountered and as may affect the construction operations.
3. The Contractor shall protect all public utility installations and structures from damage during the work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the Engineer. The Contractor shall so arrange his operations as to avoid any damage to these facilities. All required protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor which are shown on the Drawings or have been located in the field by the utility shall be repaired by the Contractor, at his expense, as directed by the Engineer. No separate payment shall be made for such protection or repairs to public utility installations or structures.
4. Public utility installations or structures owned or controlled by the Owner or other governmental body which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as a part of the general cost of doing the work and shall be included in the prices bid for the various contract items. No separate payment shall be made therefore.
5. Where public utility installations of structures owned or controlled by the Owner or other governmental body are encountered during the course of the work, and are not indicated on the Drawings or in the Specifications, and, when, in the opinion of the Engineer, removal, relocation, replacement or rebuilding is necessary to complete the work under this Contract, such work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the Engineer, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as

required. if such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement.

6. The Contractor shall, at all times in performance of the work, employ approved methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage or destruction of public utility installations and structures; and shall, at all times in the performance of the work, avoid unnecessary interference with, or interruption of, public utility services, and shall cooperate fully with the owners thereof to that end.
7. The Contractor shall give written notice to Owner, other governmental utility departments and other owners of public utilities of the location of his proposed construction operations, at least forty-eight hours in advance of breaking ground in any area or on any unit of the work.
8. The maintenance, repair, removal, relocation or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the Owners of such utilities.

### 1.03 DRAWINGS AND PROJECT MANUAL

- A. Drawings: When obtaining data and information from the Drawings, figures shall be used in preference to scaled dimensions, and large scale drawings in preference to small scale drawings.
- B. Copies Furnished to Contractor:
  1. After the Contract has been executed, the Contractor will be furnished one (1) complete set of reproducible full size drawings (24 inches by 36 inches) on bond paper and one (1) copy of the Project Manual (Contract Requirements and Specifications) and all addenda.
  2. The Contractor shall furnish each of the subcontractors, manufacturers, and material suppliers such copies of the Contract Documents as may be required for their work. All copies of the Contract Documents shall be printed from the reproducible sets furnished to the Contractor. All costs of reproduction and printing shall be borne by the Contractor.
- C. Supplementary Drawings:
  1. When, in the opinion of the Engineer, it becomes necessary to explain more fully the work to be done or to illustrate the work further or to show any changes which may be required, drawings known as Supplementary Drawings, with specifications pertaining thereto, will be prepared by the Engineer and the Contractor will be furnished one (1) complete set of drawings (24 inches by 36 inches) and one (1) copy of the Project Manual.
  2. The Supplementary Drawings shall be binding upon the Contractor with the same force as the Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of work, credit to the Owner

or compensation therefore to the Contractor shall be subject to the terms of the Agreement.

D. Contractor to Check Drawings and Data:

1. The Contractor shall verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, schedules, Specifications or other data received from the Engineer, and shall notify him of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction or improper operation resulting there from nor from rectifying such conditions at his own expense. He will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Engineer, should such errors or omissions be discovered.
2. All schedules are given for the convenience of the Engineer and the Contractor and are not guaranteed to be complete. The contractor shall assume all responsibility for the making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.

E. Specifications: The Technical Specifications consist of three parts: General, Products and Execution. The General Section contains General Requirements which govern the work. Products and Execution modify and supplement these by detailed requirements for the work and shall always govern whenever there appears to be a conflict.

F. Intent:

1. All work called for in the Specifications applicable to this Contract, but not shown on the Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Drawings or in the Specifications, but involved in carrying out their intent or in the complete and proper execution of the work, is required and shall be performed by the Contractor as though it were specifically delineated or described.
2. The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these Specifications shall be made upon that basis.

## 1.04 MATERIALS AND EQUIPMENT

A. Manufacturer:

1. The names of proposed manufacturers, material suppliers, and dealers who are to furnish materials, fixtures, equipment, appliances or other fittings shall be

submitted to the Engineer for approval, as early as possible, to afford proper investigation and checking. Such approval must be obtained before Shop Drawings will be checked. No manufacturer will be approved for any materials to be furnished under this Contract unless he shall be of good reputation and have a plant of ample capacity. He shall, upon the request of the Engineer, be required to submit evidence that he has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

2. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the Engineer, that the manufacturer or subcontractor deal directly with the Engineer. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
3. Any two or more pieces of material or equipment of the same kind, type or classification, and being used for identical types of service, shall be made by the same manufacturer.

B. Delivery:

1. The Contractor shall deliver materials to the site in ample quantities to insure the most speedy and uninterrupted progress of the work so as to complete the work within the allotted time. However, the Contractor shall not store materials on site for more than thirty days before installation.
2. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Contractor.
3. All materials and equipment shall be properly stored on site in accordance with these specifications and the manufacturer's recommendations.

C. Tools and Accessories:

1. The Contractor shall, unless otherwise stated in the Contract Documents, furnish with each type, kind or size of equipment, one complete set of suitably marked high grade special tools and appliances which may be needed to adjust, operate, maintain or repair the equipment. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good grade cylinder locks and duplicate keys.
2. Spare parts shall be furnished as specified.
3. Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight and principal rate data.

D. Service of Manufacturer's Engineer:

1. The Contract prices for equipment shall include the cost of furnishing a competent and experienced Engineer or superintendent who shall represent the

manufacturer and shall assist the Contractor, when required, to install, adjust, test and place in operation, the equipment in conformity with the Contract Documents.

2. After the equipment is placed in permanent operation by the Owner, such engineer or superintendent shall make all adjustments and tests required by the Engineer to prove that such equipment is in proper and satisfactory operating condition, and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

## 1.05 INSPECTION AND TESTING

### A. General:

1. Inspection and testing of materials will be provided by the Contractor unless otherwise specified.
2. For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Five copies of the reports shall be submitted and authoritative certification thereof must be furnished to the Engineer as a prerequisite for the acceptance of any material or equipment.
3. If, in the making of any test of any material or equipment, it is ascertained by the Engineer that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the work and replace it with acceptable material, without cost to the Owner.
4. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.
5. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner normally takes over the operation thereof.

### B. Costs:

1. Inspection and testing of materials furnished under this Contract will be provided by the Owner, unless otherwise specified.
2. The cost of shop and field tests of equipment and certain other tests specifically called for in the Contract Documents shall be borne by the Contractor and such costs shall be deemed to be included in the Contract price.
3. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the Owner for

compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests of materials and equipment which are rejected for non-compliance.

C. Inspection of Materials:

1. The Contractor shall give notice in writing to the Engineer, sufficiently in advance of his intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of commencement and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, the Engineer will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials or he will notify the Contractor that the inspection will be made at a point other than the point of manufacture.
2. The Contractor must comply with these provisions before shipping any material. Such inspection shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Certificate of Manufacture:

1. When inspection is waived or when the Engineer so requires, the Contractor shall furnish to him authoritative evidence in the form of Certificate of Manufacture that the materials to be used in the work have been manufactured and tested in conformity with the Contract Documents.
2. These certificates shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

E. Shop Tests:

1. Testing for pressure, duty, capacity, rating, efficiency, performance, function or special requirements which are specified shall be tested in the shop of the maker in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents.
2. No such equipment or materials shall be shipped to the work site until the Engineer notifies the Contractor, in writing, that the results of such tests are acceptable.
3. Five copies of the manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to be a responsible official of the manufacturing company and/or independent laboratory, shall be forwarded to the Engineer for approval.
4. The cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor.



F. Final Field Tests:

1. Upon completion of the work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance tests as specified or required to provide compliance with the Contract Documents.
2. The Contractor shall furnish labor, fuel, energy, water and all other materials, equipment and instruments necessary for all acceptance tests, at no additional cost to the Owner. The furnishing Contractor shall assist in the final field tests as applicable.

G. Final Inspection: During such final inspections, the work shall be clean and functional. In no case will the final estimate be prepared until the Contractor has complied with all requirements set forth and the Engineer and Owner have made their final inspection of the entire work and are satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

1.06 TEMPORARY STRUCTURES

- A. Temporary Fences: If, during the course of the work, it is necessary to remove or disturb any fence or part thereof, the Contractor shall provide a suitable temporary fence at his own expense.
- B. Responsibility for Temporary Structures: In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary structures or work and for any damage which may result from their failure or their improper construction, maintenance or operation and will indemnify and hold harmless the Owner and Engineer from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

1.07 ACCIDENT PREVENTION

- A. Precautions shall be exercised at all times for the protection of person and property. The safety provisions of applicable laws, building and construction codes shall be observed.
- B. The Contractor shall comply with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596), and under Hours and Safety Standards Act Section 107 of the contract Work. Hours and Safety Standards Act (PL 91-54), except where state and local safety standards exceed the federal requirements and except where state safety standards have been approved by the Secretary of Labor in accordance with provisions of the Occupational Safety and Health Act, shall be complied with.
- C. First Aid: The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when men are employed on the work.

## 1.08 LINES AND GRADES

### A. Grade:

1. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings, or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.
2. Bench marks and base line controlling points shall be established prior to beginning work. Reference marks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The Contractor shall also place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. Contractor shall remove any obstructions placed contrary to this provision.

### B. Surveys:

1. The Contractor shall furnish and maintain, at his own expense, stakes and other such materials, and give assistance, including qualified helpers, for setting reference marks to the satisfaction of Utilities and the Engineer.
2. The Contractor shall check such reference marks by such means as he may deem necessary and, before using this, shall call the Utilities' attention to any inaccuracies.
3. The Contractor shall, at his own expense, establish all working or construction lines and grades as required from the reference marks and shall be solely responsible for the accuracy thereof. However, the Contractor shall be subject to the check and review by Utilities. Field engineering shall be in accordance with Section 01050.
4. The Contractor shall, at his own expense, provide a surveyor to survey and monument all easements or proposed easements on private property prior to the start of Utilities Work. Monuments shall be preserved throughout the Work.
5. The Contractor shall, at his own expense, provide a Surveyor to survey stake or monument the proposed Right-of-Way of property to be turned over to the Public prior to the start of Utilities Work. Monuments shall be preserved throughout the Work.

### C. Safeguarding Marks:

1. The Contractor shall safeguard all points, stakes, grade marks, monuments and bench marks made or established on the work, bear the cost of reestablishing them if disturbed, and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or to removing without authorization such established points, stakes and marks.
2. The Contractor shall safeguard all existing and known property corners, monuments and marks adjacent to but not related to the work and, if required, shall bear the cost of reestablishing them if disturbed or destroyed.

## 1.09 ADJACENT STRUCTURES AND LANDSCAPING

### A. Responsibility:

1. The Contractor shall also be entirely responsible and liable for all damage or injury as a result of his operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the work.
2. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the work, whether or not shown on the Drawings, and the removal, relocation and reconstruction of such items called for on the Drawings or specified shall be included in the various Contract Items and no separate payments will be made therefore.
3. Contractor is expressly advised that the protection of buildings, structures, tanks, pipelines, etc. and related work adjacent and in the vicinity of his operations, wherever they may be, is solely his responsibility.
4. Conditional inspection of buildings or structures in the immediate vicinity of the project which may reasonably be expected to be affected by the Work shall be performed by and be the responsibility of the Contractor.
5. Contractor shall, before starting operations, make an examination of the adjacent structures, buildings, facilities, etc., and record by notes, measurements, photographs, etc., conditions which might be aggravated by open excavation and construction. Repairs or replacement of all conditions disturbed by the construction shall be made to the satisfaction of the Owner and to the satisfaction of the Owner. This does not preclude conforming to the requirements of the insurance underwriters. Copies of surveys, photographs, reports, etc., shall be given to the Owner.
6. Prior to the beginning of any excavations the Contractor shall advise the Owner of all structures on which he intends to perform work or which performance of the project work will affect.

B. Protection of Trees and Shrubs: The Contractor at his expense, shall protect all trees and shrubs not shown to be removed on the Plans, in accordance with "Article VIII, 'Tree Protection and Removal', Chapter 15, Orange County Code". No excavated materials shall be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced in accordance with "Article VIII, 'Tree Protection and Removal', Chapter 15, Orange County Code" at the sole expense of the Contractor.

C. Protection of Lawn Areas: Lawn areas shall be left in as good or better condition as before starting of the Work. Where sod is to be removed, it shall be carefully restored with new sod of the same type.

D. Restoration of Fences:

1. Any fence, or part thereof, that is damaged or removed during the course of the Work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work. The manner in which the fence is repaired or replaced and the materials used shall be subject to the approval of Utilities.
2. The cost of all labor, materials, equipment, and work for the replacement or repair of any fence shall be deemed included in the appropriate Contract Item or items, or if no specific item is provided therefore, as part of the overhead cost of the work, and no additional payment will be made therefore.

#### 1.10 PROTECTION OF WORK AND PUBLIC

##### A. Barricades, Guards and Safety Provisions:

1. The Contractor shall be solely responsible for adhering to the rules and regulations of OSHA and appropriate authorities regarding safety provisions. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, lights and guards as required shall be placed and maintained by the Contractor at his expense during the progress of the Work and until it is safe for traffic to use the roads and streets. Material piles, equipment and pipe which may serve as obstructions for traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor.
2. Signage and barricades shall be in accordance with applicable FDOT manuals.

##### B. Noise:

1. The Contractor shall eliminate noise to as great an extent as practicable at all times. Air compressing equipment shall be equipped with silencers and the exhaust of all gasoline motors or other power equipment shall be provided with mufflers. The Contractor shall construct sound barriers as necessary to eliminate noise.
2. Work shall be performed during normal working hours and normal working days unless written authorization has been granted by Owner and overtime pay for inspection shall apply per the current Fee Directory prepared by Orange County OMB. Work shall not be performed outside the hours of 7:00 a.m. to 7:00 p.m. Prior to any Work, written notification shall be provided to Utilities a minimum of two normal working days.

##### C. Access to Public Services: Neither the materials excavated nor the materials or equipment used in the construction of the work shall be so placed as to prevent free access to public services. All excavated material shall be piled in a safe manner that will not endanger the Work and that will avoid obstructing streets, sidewalks and driveways. Excavated material suitable for backfilling shall be stockpiled separately on the site. No material shall be placed closer than two feet from the edge of an excavation. Fire hydrants, valve pit covers, valve boxes, curb stop boxes or other utility controls shall be left unobstructed and accessible. Gutters shall be kept clear or

other satisfactory provisions made for street drainage. Natural watercourses shall not be obstructed or polluted. Surplus material and excavated material unsuitable for backfilling shall be transported and disposed of off the site in disposal areas obtained by the Contractor.

- D. Dust Prevention: The Contractor shall prevent dust nuisance from his operations or from traffic by keeping the roads and/or construction areas sprinkled with water at all times.

#### 1.11 CUTTING AND PATCHING

- A. The Contractor shall do all cutting, fitting or patching of his portion of the work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the Engineer and in accordance with the Drawings and Specifications.
- B. The work must be done by competent workmen skilled in the trade required by the restoration.

#### 1.12 CLEANING

- A. During Construction:
  - 1. During construction the Contractor shall, at all times, keep the construction site and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of Utilities, such material, debris, or rubbish constitutes a nuisance or is objectionable. The Contractor shall implement appropriate best management practices (BMPs) to prevent off-site tracking of material, and if tracking occurs, shall use all means necessary to remove the material, prevent material from entering roadway stormwater system and will adjust the associated BMPs to prevent future tracking.
- B. Final Cleaning:
  - 1. At the conclusion of the work, all tools, temporary structures and materials belonging to the Contractor shall be promptly taken away. The Contractor shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances in a legal manner.
  - 2. The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver such materials and equipment undamaged in a bright, clean, polished and new operating condition.
- C. Salvage
  - 1. Any existing Utilities owned equipment or material including but not limited to valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction, may be designated as salvage by Utilities, and if so,

shall be carefully excavated if necessary and delivered to Utilities at a location designated by Utilities.

### 1.13 MISCELLANEOUS

#### A. Protection Against Siltation and Bank Erosion:

1. The Contractor shall arrange his operations and construct erosion control devices to minimize siltation and bank erosion on construction sites and on existing or proposed water course and drainage channels.
2. The Contractor, at his own expense, shall remove any siltation deposits and correct any erosion problems as directed by the Engineer which results from his construction operations.
3. The Contractor shall follow federal, state and local permit requirements.

#### B. Protection of Wetland Areas:

1. The Contractor shall properly dispose of all surplus material, including soil, in accordance with local, state and federal regulations.
2. Under no circumstances shall surplus material be disposed of in wetland areas as defined by the Florida Department of Environmental Protection or the wetland areas under construction under this project.

#### C. Erosion and Sediment Control

1. Erosion and sediment control implemented as part of a SWPPP is performance based. If the best management practices (BMPs) initially installed are not maintaining compliance with the permit, the BMPs shall be adjusted or replaced in order to achieve compliance.
2. If BMPs originally included in the SWPPP are changed, the SWPPP document shall be adjusted to reflect the change.

#### D. Existing Facilities: The work shall be so conducted to maintain existing traffic lanes in operation.

#### E. Use of Chemicals: Chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must indicate approval of either United States Environmental Protection Agency, National Safety Foundation, or United States Department of Agriculture. Use of such chemicals and disposal of residues shall be in strict conformance with label instructions. Material Safety Data Sheets (MSDS) for chemicals used during project construction shall be submitted to Utilities for approval.

#### F. Cooperation with Other Contractors and Forces:

1. During progress of work under this Contract, it may be necessary for other contractors and persons employed by the Owner to work in or about the project.
  2. The Owner reserves the right to put such other contractors to work and to afford such access to the Site of the Work to be performed hereunder at such times as the Owner deems proper.
  3. The Contractor shall not impede or interfere with the work of such other contractors engaged in or about the Work and shall so arrange and conduct his work that such other contractors may complete their work at the earliest date possible.
- G. Construction shall be conducted and shall result in construction of the improvements of this project in full accordance with the conditions of the permits granted for the project.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01010**  
**SUMMARY OF PROJECT**

**PART 1 - GENERAL**

1.01 WORK COVERED BY CONTRACT DOCUMENTS

1.02 This Contract is for the construction of the Orange County Hypochlorite Storage Improvements Project consists of mechanical, electrical and instrumentation and control improvements associated with the installation of three new 7,300-gallon single-wall, vertical polyethylene storage tanks under a new metal roofed structure with a concrete containment area. New PVC single-wall feed piping will be installed from metering pump skids at the new hypochlorite storage area to the dosing points at Phase II and Phase III injection locations, as well as provisions to accommodate the Phase V improvements including Phase V pump skid. Piping from the Phase V skid will be stubbed and capped allowing the building to remain undisturbed during the future construction. The proposed PLC will communicate with the SCADA via fiber optic cable, which will run to the existing fiber patch panel located at the shed located east of the existing outdoor sodium hypochlorite storage tanks. The fiber will be extended by others to the Phase V West Electric Building during Phase V as shown on the Drawings and specified herein. Work consists of furnishing all labor, equipment, and materials for the construction of the facilities consisting of, but not limited to the equipment and structures associated with the following:

1. All associated mechanical piping, valves, fittings, wiring and pump accessories required for the installation of pump skids, hypochlorite storage tanks, and piping to dosage points
2. All associated modifications to the existing fire hydrant
3. All associated work required for the Fire Protection
4. All associated work required for the Storage Facility
5. All associated site work and grading required
6. All associated electrical
7. Instrumentation and controls for system operation and monitoring.

1.03 CONTRACTOR'S USE OF PREMISES

- A. The Contractor shall assume full responsibility for the protection and safekeeping of products and materials at the job site. If additional storage or work areas are required, they shall be obtained by the Contractor at no additional cost to the Owner.

1.04 PROJECT SEQUENCE



- A. The Contractor shall establish his work sequence based on the use of crews to facilitate completion of construction and testing within the specified Contract Time.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01014**  
**SEQUENCE OF CONSTRUCTION**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This section includes work sequence requirements necessary for maintaining operation of the facility during construction, including, but not necessarily limited to, the following:
1. General construction sequence requirements.
  2. Specific construction sequence requirements.
  3. Modifications which must be performed according to a specific sequence include the following:
    - a. Hypochlorite Storage Structure
    - b. Tanks
    - c. Metal Building
    - d. Phase III Pump Skids and Adjacent Stand-By Pump Skid
    - e. Phase III Sodium Hypochlorite Yard and Dosing Piping
    - f. Piping and Valves
    - g. Electrical
    - h. SCADA and I&C
    - i. Potable Water Piping
    - j. Startup of Items Listed Previously
    - k. Phase I/II Pump Skid (Relocation of Existing Phase III Pump Skid)
  4. Modifications which do not have to be performed according to a specific sequence (other than individual process sequences) include the following:
    - a. Phase I/II Sodium Hypochlorite Yard and Dosing Piping
    - b. Phase V Pump Skid
    - c. Phase V Sodium Hypochlorite Yard Piping

1.02 RELATED SECTIONS

- A. Project Coordination is included in Section 01041.
- B. Construction Progress Schedules are included in Section 01310.
- C. Electrical is included in Division 16.
- D. Process Instrumentation and Controls are included in Section 13300.

1.03 GENERAL CONSTRUCTION SEQUENCE REQUIREMENTS

- A. All work shall be performed in a manner that allows continuous operation of the facilities and shall be closely coordinated with on-site County personnel. No lines or valves shall be opened or closed or otherwise altered or equipment turned off or on

without authorization and supervision by on-site County personnel. Authorization must be requested in writing at least 48 hours in advance.

- B. Sequences of work shall be included as a part of the Progress Schedule required under Section 01310, Construction Progress Schedules.
- C. Construction must be performed in the sequence indicated below unless an alternate plan is proposed by the Contractor and approved by the County and the Engineer. All equipment being installed as part of the modifications being performed must be tested for proper operation and piping associated with the modifications being performed must be pressure tested prior to proceeding with the relocation of the existing Phase III Pump Skid for use as Phase I/II Pump Skid.

#### 1.04 SPECIFIC CONSTRUCTION SEQUENCE REQUIREMENTS

- A. Phase III Sodium Hypochlorite Dosing Capability
  - 1. Storage Facility
    - a. Sitework and Hypochlorite Storage Structure including tank pedestals
    - b. Hypochlorite Storage Tanks
    - c. Metal Building
  - 2. Phase III and Stand-by Pumping System Construction
    - a. Phase III Pump Skids and Adjust Standing Pump Skid
    - b. Phase III Sodium Hypochlorite Yard Piping and Dosing Piping
    - c. Piping and Valves associated with the Phase III and Stand-By Pump Skids, and the storage tanks.
  - 3. Power, Controls, Safety
    - a. Electrical for Phase III and Standby Pump Skids, Storage Tanks, Storage Structure, Metal Buildings, SCADA, and Instrumentation & Controls (I&C).
    - b. SCADA and I&C for Phase III and Standby Pump Skids, Storage Tanks, and Storage Structure.
    - c. Potable Water Piping, Relocated Hydrant, Hose Bibs and Hoses, and Emergency Eyewash/Shower.
  - 4. Phase III Sodium Hypochlorite Startup
    - a. Startup items 1 through 3.
  - 5. Relocate Existing Pump Skid as Phase I/II Pump Skid
    - a. After Phase III Sodium Hypochlorite is satisfactorily disinfecting Phase III reclaimed water, and after receiving Owner's approval, coordinate shutdown and cleaning of existing Phase III Pump Skid, disconnect, relocate to Phase I/II Pump Skid location, and make ready for operation.
  - 6. The remainder of work shall then be performed.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01025  
MEASUREMENT AND PAYMENT**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. The Contractor shall receive and accept the compensation provided in the Proposal and the Contract as full payment for furnishing all materials, labor, tools and equipment, for performing all operations necessary to complete the work under the Contract, and also in full payment for all loss or damages arising from the nature of the work, or from any discrepancy between the actual quantities of work and quantities herein estimated by the Engineer, or from the action of the elements of from any unforeseen difficulties which may be encountered during the prosecution of the work until the final acceptance by the Owner.
- B. The prices stated in the proposal include all costs and expenses for taxes, labor, equipment, materials, commissions, transportation charges and expenses, patent fees and royalties, labor for handling materials during inspection, together with any and all other costs and expenses for performing and completing the work as shown on the Drawings and specified herein. The basis of payment for an item at the unit price shown in the proposal shall be in accordance with the description of that item in this Section.
- C. The Contractor's attention is again called to the fact that the quotations for the various items of work are intended to establish a total price for completing the work in its entirety. Should the Contractor feel that the cost for any item of work has not been established by the Bid Form or Payment Items, he shall include the cost for that work in some other applicable bid item, so that his proposal for the project does reflect his total price for completing the work in its entirety.

1.02 MEASUREMENT

- A. The quantities for payment under this Contract shall be determined by actual measurement of the completed items, in place, ready for service and accepted by the Owner, in accordance with the applicable method of measurement therefore contained herein.

1.03 PAYMENT

- A. Payment will be made at the lump sum price for each of the items shown in the Bid Proposal, stored and/or installed and accepted, which price and payment shall constitute full compensation for furnishing all materials and performing all Work in connection therewith and incidental thereto.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01027**  
**APPLICATIONS FOR PAYMENTS**

**PART 1 - GENERAL**

1.01 PAY REQUEST SUBMISSION

- A. Submit applications for payment to the Engineer in accordance with the schedule established by General Conditions of the Contract between the Owner and Contractor.

1.02 FORMAT AND DATA REQUIRED

- A. Submit applications typed on forms provided by the Owner, with itemized data typed on 8-1/2 inch x 11 inch or 8-1/2 inch x 14 inch white paper continuation sheets.
- B. Provide itemized data on continuation sheet of format, schedules, line items and values: Those of the schedule of values accepted by the Engineer.

1.03 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

A. Application Form:

- 1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.
- 2. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.
- 3. Execute certification with signature of a responsible officer of Contract firm.

B. Continuation Sheets:

- 1. Fill in total list of all scheduled component items of work, with item number and scheduled dollar value for each item.
- 2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored. Round off values to nearest dollar, or as specified for Schedule of Values.
- 3. List each Change Order executed prior to date of submission, at the end of the continuation sheets. List by Change Order Number, and description, as for an original component item of work.
- 4. To receive approval for payment on component material stored on site, submit copies of the original paid invoices with the application for payment. Any materials stored on site that are included in the pay request must be installed prior to the next pay request submitted.



5. As provided for in the "Pay Estimate" form, the Contractor shall certify, for each current pay request, that all previous progress payment received from the Owner, under this Contract, have been applied by the Contractor to discharge in full all obligations of the Contractor in connection with Work covered by prior Applications for Payment, and all materials and equipment incorporated into the Work are free and clear of all liens, claims, security interest and encumbrances. Contractor shall attach to each Application for Payment like affidavits by all Subcontractors.

#### 1.04 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. When the Owner or the Engineer requires substantiating data, Contractor shall submit suitable information, with a cover letter identifying:
  1. Project.
  2. Application number and date.
  3. Detailed list of enclosures.
  4. For stored products:
    - a. Item number and identification as shown on application.
    - b. Description of specific material.
- B. Submit one copy of data and cover letter for each copy of application.
- C. As a prerequisite for payment, Contractor is to submit a "Surety Acknowledgement of Payment Request" letter showing amount of progress payment which the Contractor is requesting.
- D. The Contractor is to maintain an updated set of drawings to be used as record drawings in accordance with Section 01720. As a prerequisite for monthly progress payments, the Contractor is to exhibit the updated record drawings for review by the Owner and the Engineer.

#### 1.05 PREPARATION OF APPLICATION FOR FINAL PAYMENT

- A. Fill in Application form as specified for progress payments.

#### 1.06 SUBMITTAL PROCEDURE

- A. Submit Applications for Payment to the Engineer at the time stipulated in the Agreement.
- B. Number of copies for each Application for Payment:
  1. Owner: Five (5) copies
  2. Engineer: One (1) copy

3. Contractor: As required for his needs
- C. When the Engineer finds Application properly completed and correct, he will transmit certificate for payment to Owner, with copy for Contractor.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01041  
PROJECT COORDINATION**

**PART 1 - GENERAL**

1.01 PIPE LOCATIONS

- A. Pipelines shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

1.02 OPEN EXCAVATIONS

- A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by workmen.

1.03 TEST PITS

- A. Test pits for the purpose of locating underground pipelines or structures in advance of the construction shall be excavated and backfilled by the Contractor. Test pits shall be backfilled immediately after their purpose has been satisfied and maintained in a manner satisfactory to the Engineer. The costs for such test pits shall be borne by the Contractor.

1.04 CARE AND PROTECTION OF PROPERTY

- A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the Engineer.

1.05 COOPERATION WITHIN THIS CONTRACT

- A. The Contractor shall, prior to interrupting a utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the

Owner and make arrangements for the interruption which will be satisfactory to the Owner.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01050  
FIELD ENGINEERING**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Provide and pay for field engineering services for the Project.
1. Survey work required in execution of the Project.
  2. Civil, structural or other professional engineering services specified or required to execute Contractor's construction methods.
  3. The method of field staking for the construction of the work shall be at the option of the Contractor. The Drawings provide the engineering surveys to establish reference points which were judged necessary to enable the Contractor to proceed with his work.
  4. The accuracy of any method of staking shall be the responsibility of the Contractor. All engineering for vertical and horizontal control shall be the responsibility of the Contractor.
  5. The Contractor shall be held responsible for the preservation of all stakes and marks. If any stakes or marks are carelessly or willfully disturbed by the Contractor, the Contractor shall not proceed with any work until he has established such points, marks lines and elevations as may be necessary for the prosecution of the work.
  6. The Contractor shall retain the services of a registered land surveyor licensed in the State of Florida to identify existing control points and maintain a survey during construction and for record drawing purposes.

1.02 QUALIFICATIONS OF SURVEYOR OR ENGINEER

- A. Qualified engineer or registered land surveyor, acceptable to the Owner and the Engineer.
- B. Registered professional engineer of the discipline required for the specific service on the Project, currently licensed in the State of Florida.

1.03 SURVEY REFERENCE POINTS

- A. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction.
1. Make no changes or relocations without prior written notice to the Engineer.

2. Report to the Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
3. Require surveyor to replace Project control points which may be lost or destroyed at no additional cost to the Owner. Establish replacement based on original survey control.

#### 1.04 PROJECT SURVEY REQUIREMENTS

- A. Establish a minimum of two permanent bench marks on site, referenced to data established by survey control points.
  1. Record locations, with horizontal and vertical data, on Project Record Documents.
- B. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:
  1. Site improvements:
    - a. Stakes for grading, fill and topsoil replacement.
    - b. Utility slopes and invert elevations.
  2. Batter boards for structures.
  3. Building foundations, column locations and floor levels.
  4. Controlling lines and levels required for mechanical and electrical trades.
- C. From time to time, verify layouts by same methods.

#### 1.05 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses. The Contractor shall be responsible for recording information on the approved plans concurrently with construction progress.
- B. The Contractor's Surveyor shall be responsible for surveying utility assets concurrently (at a minimum monthly) with construction progress and providing as-built data to the Contractor. Monthly survey data and Contractor as-builts shall be retained on the project site and made available to the Utilities representative.
- C. Record drawings shall be legibly marked to record actual construction.
- D. At the end of the project, submit a record drawing markup set of the original drawings, indicating the building corners and location of all structures, and road intersections.
- E. At the end of the project, submit a record drawing markup set of the original drawings indicating elevations and stationing at 100 foot increments and for all valve and fitting locations.

- F. As-Built Asset Attribute Data Table (See Table 3111-2 of the Orange County Standards and Construction Specifications Manual). The Contractor's Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements for the table and include the Surveyor's statement regarding the constructed improvements being within the specified accuracies as described in the Table 3111-1 Minimum Survey Accuracies per Asset (Water, Wastewater, Reclaimed Water and Existing) of the Orange County Standards and Construction Specifications Manual or if not, indicating the variances. Utilities will provide an electronic version of a blank table that shall be used to input data.
- G. At the end of the project, submit an electronic survey file of both surveys depicted in D and E above in AutoCAD 2008 or other Engineer approved version of AutoCAD. Submit an electronic file of the As-Built Asset Attribute Data Table as depicted in F above.

#### 1.06 SUBMITTALS

- A. Submit name and address of Surveyor and professional engineer to the Engineer.
- B. On request of the Engineer, submit documentation to verify accuracy of field engineering work.
- C. Submit certificate signed by registered engineer or surveyor certifying that elevations and locations of improvements are in conformance with the Contract Documents, or if not in conformance, certify as to variances from the Contract Documents.
- D. Submit drawings showing locations of all structures constructed. This drawing shall be included with the project record documents.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**



**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01065  
PERMITS AND FEES**

**PART 1 - GENERAL**

- A. The Contractor shall secure and pay for **all** permits and licenses related to his work, including but not limited to, the necessary construction permits, as provided for in Section 00700: General Conditions except as otherwise provided herein.
- B. Permits by Owner: The Owner prior to the advertisement of the project has applied for permits with the following agencies:
  - 1. Orange County Building Permit Application

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01070  
ABBREVIATIONS AND SYMBOLS**

**PART 1 - GENERAL**

1.01 STANDARDS AND ABBREVIATIONS

- A. Referenced Standards: Any reference to published specifications or standards of any organization or association shall comply with the requirements of the specification or standard which is current on the date of Advertisement for Bids. In case of a conflict between the referenced specifications or standards, the one having the more stringent requirements shall govern.
- B. In case of conflict between the referenced specifications or standards and the Contract Documents, the Contract Documents shall govern.
- C. Abbreviations:

AA	Aluminum Association
AAA	American Arbitration Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHO	The American Association of State Highway Officials
ABA	American Bar Association
ABMA	American Boiler Manufacturers Association
ABPA	Acoustical and Board Products Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Anti-Friction Bearing Manufacturers Association
AGA	American Gas Association
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturers Association

AHA	American Hardboard Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIA	American Insurance Association
AIEE	American Institute of Electrical Engineers (Now IEEE)
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Condition Association
ANSI	American National Standard Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ARI	American Refrigeration Institute
ASA	American Standards Association (Now ANSI)
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSCBC	American Standard Safety Code for Building Construction
ASSHTO	American Association of State Highway Transportation Officials
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge

AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CFS	Cubic Feet Per Second
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
DOT Spec	Standard Specification for Road and Bridge Construction Florida Department of Transportation, 1982
E/A	Engineer and/or Architect
EDA	Economic Development Association
EEI	Edison Electric Institute
EPA	Environmental Protection Agency
FCI	Fluid Control Institute
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
Fed Spec	Federal Specification
FPS	Feet Per Second

FS	Federal Standards
GPM	Gallons Per Minute
HMI	Hoist Manufacturers Institute
HP	Horsepower
HSBII	Hartford Steam Boiler Inspection and Insurance Co.
ID	Inside Diameter
IEEE	Institute of Electrical and Electronic Engineers
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IPS	Iron Pipe Size
MGD	Million Gallons Per Day
MHI	Materials Handling Institute
MMA	Monorail Manufacturers Association
NBFU	National Board of Fire Underwriters
NBHA	National Builders' Hardware Association
NBS	National Bureau of Standards
NCSA	National Crushed Stone Association
NCSPA	National Corrugated Steel Pipe Association
NEC	National Electrical Code
NECA	National Electrical Contractors' Association
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Threads

NSC	National Safety Council
NSF	National Sanitation Foundation
OD	Outside Diameter
OSHA	U.S. Department of Labor, Occupational Safety and Health Act
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	United States Products Standards
PSI	Pounds per Square Inch
PSIA	Pounds per Square Inch Absolute
PSIG	Pounds per Square Inch Gauge
RAS	Return Activated Sludge
RPM	Revolutions Per Minute
SAE	Society of Automotive Engineers
SDI	Steel Decks Institute
SJI	Steel Joists Institute
SJRWMD	St. Johns River Water Management District
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
SSPC	Structural Steel Painting Council
STA	Station (100 feet) Intervals
TDH	Total Dynamic Head
TH	Total Head
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.



USASI or United States of America Standards Institute

Additional abbreviations and symbols are shown on the Drawings.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01100  
SPECIAL PROJECT PROCEDURES**

**PART 1 - GENERAL**

1.01 PUBLIC NUISANCE

- A. The Contractor shall not create a public nuisance including, but not limited to, encroachment on adjacent lands, flooding of adjacent lands, or excessive noise or dust. The Contractor shall eliminate noise to as great an extent as practicable at all times.
- B. Sound levels measured by the Engineer shall not exceed 50 dBA from 7 P.M. to 7 A.M. or 60 dBA 7 A.M. to 7 P.M. This sound level shall be measured at the exterior of the nearest exterior wall of the nearest residence. Levels at the equipment shall not exceed 85 dBA at any time. Dewatering pumps and bypass pumps shall have a maximum rating of 55 dBA for sound attenuation. Sound levels in excess of these values are sufficient cause to have the Work halted until equipment can be quieted to these levels. Work stoppage by the Engineer or Owner for excessive noise shall not relieve the Contractor of the other portions of this Specification including, but not limited to, completion dates and bid amounts.
- C. No extra charge may be made for time lost due to work stoppage resulting from the creation of a public nuisance.

1.02 JURISDICTIONAL DISPUTES

- A. It shall be the responsibility of the Contractor to pay all costs that may be required to perform any of the Work shown on the Drawings or specified herein in order to avoid any work stoppages due to jurisdictional disputes. The basis for subletting Work in question, if any, shall conform with precedent agreements and decisions on record with the Building and Construction Trades Department, AFL-CIO, dated June, 1973, including any amendments thereto.

1.03 HAULING AND CONSTRUCTION OPERATIONS ON SITE

- A. The Contractor shall conduct access, hauling, filling, and storage operations as specified herein and as shown on the Contract Drawings.
  - 1. On-site borrow areas are designated as follows: All borrow material shall be provided by the Contractor from on-site stockpile area.
  - 2. On-site spoil areas will become property of the Contractor.
- B. Construct all fill areas so runoff will not flood improved areas.

#### 1.04 EXCAVATION AROUND AND CONNECTION TO EXISTING UTILITIES

- A. It is essential that the Contractor understand that the existing utilities must be kept in operation with minimal impact and shut-downs. To this end, the Contractor shall coordinate and consult with the Owner's operating personnel before excavating around or cutting into existing utilities on the site. Existing utilities of major concern are wastewater, electrical power conduits and cables, instrumentation conduits and cables and drain lines.
- B. Some areas within the construction site will require hand excavation due to the congestion of underground piping systems and/or due to the criticality of piping systems that may be damaged unavoidably during machine excavation. All sodium hypochlorite distribution piping shall be installed by hand excavation.
- C. Cover for underground piping shall not be less than that indicated on the Drawings. In areas where other piping conflicts preclude the minimum cover desired, the piping shall be laid to provide the minimum cover obtainable.
- D. All connections to existing piping systems shall be made as shown or indicated on the Drawings after consultation, cooperation, and coordination with the Owner's personnel. Some such connections may have to be made during off-peak hours (late night or early morning hours). The Contractor shall give a minimum of 72 hours notice to the Owner when tie-ins with the existing utilities are required.
- E. For major utility pipeline tie-ins and relocations, the Contractor shall submit a detailed Plan of Action for review and approval by the Owner and the Engineer. No major utility relocation or tie-ins shall proceed until the Plan of Action for that Work is approved.

#### 1.05 TEMPORARY OPERATING EQUIPMENT AND FACILITIES

- A. Prior to proceeding with relocation and installation of temporary operating facilities, the Contractor shall submit a detailed Plan of Action for this work which will be reviewed and approved by the Owner and the Engineer. Because this relocation work must proceed before any renovations are commenced in these areas, the Contractor should submit his Plans of Action as soon as possible after the Notice to Proceed is issued. No relocation work shall commence until the Plans of Action are approved.
- B. The temporary facilities will include temporary enclosures, power, water supply, and process piping. Locations for connection of temporary facilities to existing facilities shall be approved in advance by the Owner and the Engineer and shall be included in the Contractor's submitted Plan of Action. The Contractor shall give a minimum of 72 hours notice to the Owner when tie-ins to existing plant piping and electrical power are required for relocations.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01200  
PROJECT MEETINGS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. The Contractor shall cooperate and coordinate with the Engineer to schedule and administer the preconstruction meeting, monthly progress meetings, and specifically called meetings throughout the progress of the Work. The Contractor shall:
  - a. Prepare agenda for meetings in electronic format.
  - b. Make physical arrangements for meetings.
  - c. Preside at meetings.
  - d. Take and distribute meeting minutes electronically.
2. Representatives of Contractor, subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
3. The Owner shall attend meetings to ascertain that the Work is expedited consistent with Contract Documents and construction schedules.
4. The Contractor shall record the preconstruction meeting and each progress meeting in its entirety, and shall provide the Engineer with a regular cassette copy of such recording, having good quality and clarity, and a typed transcript of the minutes of each meeting. A copy of the minutes of each progress meeting shall be available five business days after the meeting.

B. Related Requirements Described Elsewhere:

1. Construction Progress Schedules: Section 01310.
2. Project Record Documents: Section 01720.

1.02 PRECONSTRUCTION MEETING

- A. Engineer will schedule a preconstruction meeting no later than twenty (20) days after date of Notice to Proceed. The meeting shall be scheduled at the convenience of all parties.
- B. Location: A local site, convenient for all parties, designated by the Engineer.
- C. Attendance:

1. Owner's representative.
  2. Engineer and his professional consultants.
  3. Resident project representative.
  4. Contractor and his superintendent.
  5. Major subcontractors.
  6. Representatives of major suppliers and manufacturers as appropriate.
  7. Governmental and Utilities representatives as appropriate.
  8. Others as requested by the Contractor, Owner, and Engineer.
- D. The Engineer shall preside at the preconstruction meeting. The Contractor shall provide for keeping minutes and distribution of minutes to the Owner, Engineer and others. The purpose of the preconstruction meeting is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established.
- E. The suggested agenda for the preconstruction meeting would include the following:
1. Distribution and discussion of:
    - a. List of major subcontractors and suppliers.
    - b. Projected schedules.
    - c. Schedule of Values.
  2. Critical work sequencing: Relationships and coordination with other contracts and/or work and continuing water treatment plant operation.
  3. Major equipment deliveries and priorities.
  4. Project coordination: Designation and responsible personnel.
  5. Procedures and processing of:
    - a. Field decisions.
    - b. Proposal requests.
    - c. Request for Information.
    - d. Submittals.
    - e. Change Orders.
    - f. Applications for Payment.
  6. Submittal of Shop Drawings, project data and samples.
  7. Adequacy of distribution of Contract Documents.
  8. Procedures for maintaining Record Documents
  9. Use of premises:
    - a. Office, work, and storage areas.
    - b. Owner's requirements.

- c. Access and traffic control.
- 10. Construction facilities, controls, and construction aids.
- 11. Temporary utilities.
- 12. Safety and first aid procedures.
- 13. Check of required Bond and Insurance certifications.
- 14. Completion time for contract and liquidated damages.
- 15. Request for extension of Contract Time.
- 16. Procedures for periodic monthly (or whatever interval is deemed appropriate or necessary, however, a minimum of monthly meetings will be required) progress meetings, for all involved.
- 17. Security procedures.
- 18. Procedures for making partial payments.
- 19. Guarantees on completed work.
- 20. Equipment to be used.
- 21. Project layout and staking of work.
- 22. Project inspection.
- 23. Labor requirements.
- 24. Laboratory testing of material requirements.
- 25. Provisions for material stored on site and monthly inventory of materials stored.
- 26. Requirements of other organizations such as utilities, railroads, highway departments, building departments.
- 27. Rights-of-way and easements.
- 28. Housekeeping procedures.
- 29. Liquidated damages.
- 30. Posting of signs and installation of Project Sign.
- 31. Pay request submittal dates.
- 32. Equal opportunity requirements.

### 1.03 MONTHLY PROGRESS MEETINGS

- A. The Contractor shall schedule regular periodic meetings. The progress meetings will be held a minimum of once every thirty (30) days and at other times as required by the progress of the Work. The first meeting shall be held within thirty (30) days after the preconstruction meeting or thirty (30) days or less after the date of Notice to Proceed.



- B. Hold called meetings as required by progress of the Work.
- C. Location of the meetings: Owner/Engineer's Field Office (See Section 01500, Paragraph 2.03).
- D. Attendance:
  - 1. Engineer and his professional Subconsultants as needed.
  - 2. Resident Project Representative.
  - 3. Contractor and his Superintendent.
  - 4. Owner's representatives.
  - 5. Subcontractors (active on the site, as appropriate to the agenda).
  - 6. Others as appropriate to the agenda (suppliers, manufacturers, other subcontractors, etc.).
- E. The Contractor shall preside at the meetings and provide for keeping minutes and distribution of the minutes to the Owner, Engineer, and others. The purpose of the meetings will be to review the progress of the Work.
- F. The suggested agenda for the progress meetings will include but not be limited to the following:
  - 1. Review approval of minutes of previous meeting.
  - 2. Review of Work progress since previous meeting and Work scheduled (3-week look ahead schedule).
  - 3. Field observations, problems, conflicts.
  - 4. Problems which impede construction schedule.
  - 5. Review of off-site fabrication, delivery schedules.
  - 6. Corrective measures and procedures to regain projected schedule.
  - 7. Status of approved Construction Schedule and revisions to the Construction Schedule as appropriate.
  - 8. Progress schedule during succeeding work period.
  - 9. Coordination of schedules.
  - 10. Review status of submittals and submittal schedule, expedite as required.
  - 11. Maintenance of quality standards.
  - 12. Pending changes and substitutions.
  - 13. Shop drawing problems.
  - 14. Review proposed changes for:
    - a. Effect on Construction Schedule and on completion date.

- b. Effect on other contracts of the Project.
- 15. Critical/long lead items.
- 16. Other business.
- G. The Contractor is to attend progress meetings and is to study previous meeting minutes and current agenda items, and be prepared to discuss pertinent topics and provide specific information including but not limited to:
  - 1. Status of all submittals and what specifically is being done to expedite them.
  - 2. Status of all activities behind schedule and what specifically will be done to regain the schedule.
  - 3. Status of all material deliveries, latest contact with equipment manufacturer, and specific actions taken to expedite materials.
  - 4. Status of open deficiencies and what is being done to correct the same.
- H. The Contractor is to provide a current submittal log at each progress meeting in accordance with Section 01340: Submittals.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01310  
CONSTRUCTION PROGRESS SCHEDULES**

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit within time specified in the General Conditions.
2. Detailed Progress Schedule:
  - a. Submit initial Detailed Progress Schedule within 30 days following the Notice to Proceed date or 10 days before submission of the first Application for Payment, whichever shall first occur.
  - b. Submit an Updated Progress Schedule in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission: Contractor's certification that Progress Schedule submission is actual schedule being utilized for execution of the Work.
  - a. Disk file compatible with latest version of Project Planner (P3) by Primavera Systems, Inc. unless otherwise approved by Engineer.
  - b. Progress Schedule: Five legible copies.
  - c. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

- A. In addition to basic requirements outlined in the General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.
- B. Show activities including, but not limited to the following:
  1. Notice to Proceed.
  2. Permits.
  3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01340, Submittals.
  4. Early procurement activities for long lead equipment and materials.
  5. Initial Site work.
  6. Earthwork.

7. Specified Work sequences and construction constraints.
  8. Contract Milestone and Completion Dates.
  9. Owner-furnished products delivery dates or ranges of dates.
  10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
  11. System startup summary.
  12. Project close-out summary.
  13. Demobilization summary.
- C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.
- D. Format: In accordance with Article Progress Schedule—Critical Path Network.

#### 1.03 DETAILED PROGRESS SCHEDULE

- A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.
- B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.
- C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.
- D. Format: In accordance with Article Progress Schedule—Critical Path Network.
- E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

#### 1.04 PROGRESS SCHEDULE-CRITICAL PATH NETWORK

- A. General: Comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) 580, "Construction Project Planning and Scheduling Guidelines." If a conflict occurs between the AGC publication and this Specification, this Specification shall govern.
- B. Contents:
  1. Schedule shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.

2. Identify Work calendar basis using days as a unit of measure.
3. Show complete interdependence and sequence of construction and Project-related activities reasonably required to complete the Work.
4. Identify the Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.
5. Reflect sequences of the Work, restraints, delivery windows, review times, Contract Times and Project Milestones set forth in the Agreement and Section 01041, Project Coordination.
6. Include as applicable, at a minimum:
  - a. Obtaining permits, submittals for early product procurement, and long lead time items.
  - b. Mobilization and other preliminary activities.
  - c. Initial Site work.
  - d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s) Subcontract Work.
  - e. Major equipment design, fabrication, factory testing, and delivery dates.
  - f. Delivery dates for Owner-furnished products, as specified in Section 01010, Summary of Project.
  - g. Site Work.
  - h. Concrete Work.
  - i. Structural steel Work.
  - j. Architectural features Work.
  - k. Conveying systems Work.
  - l. Equipment Work.
  - m. Mechanical Work.
  - n. Electrical Work.
  - o. Instrumentation and control Work.
  - p. Interfaces with Owner-furnished equipment.
  - q. Other important Work for each major facility.
  - r. Equipment and system startup and test activities.
  - s. Project closeout and cleanup.
  - t. Demobilization.
7. No activity duration, exclusive of those for Submittals review and product fabrication/delivery, shall be less than 1 day or more than 30 days, unless otherwise approved.
8. Activity duration for Submittal review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from Engineer.
9. Contractor shall include a mandatory 30 days, minimum float time for utility relocation work. County will not consider Contract Time extensions related to

utility coordination matters unless the utility related delays exceed the 30 days float time and extend the critical path of the Project Schedule.

C. Network Graphical Display:

1. Plot or print on paper not greater than 30 inches by 42 inches or smaller than 22 inches by 34 inches, unless otherwise approved.
2. Title Block: Show name of Project, Owner, date submitted, revision or update number, and the name of the scheduler. Updated schedules shall indicate data date.
3. Identify horizontally across top of schedule the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Indicate the critical path.
6. Show, at a minimum, the controlling relationships between activities.
7. Plot activities on a time-scaled basis, with the length of each activity proportional to the current estimate of the duration.
8. Plot activities on an early start basis unless otherwise requested by Engineer.
9. Provide a legend to describe standard and special symbols used.

D. Schedule Report:

1. On 8-1/2-inch by 11-inch white paper, unless otherwise approved.
2. List information for each activity in tabular format, including, at a minimum:
  - a. Activity Identification Number.
  - b. Activity Description.
  - c. Original Duration.
  - d. Remaining Duration.
  - e. Early Start Date (Actual start on Updated Progress Schedules).
  - f. Early Finish Date (Actual finish on Updated Progress Schedules).
  - g. Late Start Date.
  - h. Late Finish Date.
  - i. Total Float.
3. Sort reports, in ascending order, as listed below:
  - a. Activity number sequence with predecessor and successor activity.
  - b. Early-start.
  - c. Total float.

## 1.05 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
  2. Approved changes in Work scope and activities modified since submission.
  3. Delays in Submittals or resubmittals, deliveries, or Work.
  4. Adjusted or modified sequences of Work.
  5. Other identifiable changes.
  6. Revised projections of progress and completion.
  7. Report of changed logic.
- B. Produce detailed subschedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.
- C. If Contractor fails to complete activity by its latest scheduled completion date and this Failure is anticipated to extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- D. Owner may order Contractor to increase plant, equipment, labor force or working hours if Contractor fails to:
1. Complete a Milestone activity by its completion date.
  2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

#### 1.06 NARRATIVE PROGRESS REPORT

- A. Format:
1. Organize same as Progress Schedule.
  2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.
- B. Contents:
1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
  2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
  3. Contractor's plan for management of Site (for example, lay down and staging areas, construction traffic), utilization of construction equipment, buildup of trade labor, and identification of potential Contract changes.



4. Identification of new activities and sequences as a result of executed Contract changes.
5. Documentation of weather conditions over the reporting period, and any resulting impacts to the work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

#### 1.07 SCHEDULE ACCEPTANCE

##### A. Engineer's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
  - a. Contract Times, including Final Completion and all intermediate Milestones are within the specified times.
  - b. Specified Work sequences and constraints are shown as specified.
  - c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
  - d. Access restrictions are accurately reflected.
  - e. Startup and testing times are as specified.
  - f. Submittal review times are as specified.
  - g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgement, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

##### B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.

2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, during which time Contractor shall update schedule on a monthly basis to reflect actual progress and occurrences to date.
- C. Unacceptable Detailed Progress Schedule:
1. Make requested corrections; resubmit within 10 days.
  2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.
- D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

#### 1.08 ADJUSTMENT OF CONTRACT TIMES

- A. In accordance with the General Conditions.
- B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.
- C. Schedule Contingency:
1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
  2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
  3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
  4. Pursuant to Contingency sharing provisions of this Specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.
- D. Float:
1. In accordance with the General Conditions.
- E. Claims Based on Contract Times:
1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount

of adjustment to be reflected in Progress Schedule, Contractor shall reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.

2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Contractor shall revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01340  
SUBMITTALS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work

1. The Contractor shall submit to the Engineer for review, shop drawings, test reports and data on materials and equipment (hereinafter in this article called data), material samples (hereinafter in this article called samples), and certifications as are required for materials and equipment specified in the Specifications and the Contract Drawings.
2. The Contractor shall submit to the Engineer a complete list of items for which shop drawings and/or equipment data are to be submitted. Included in this list shall be the names of all proposed manufacturers furnishing specified items. Review of this list by the Engineer shall in no way, expressed or implied, relieve the Contractor from submitting complete shop drawings and/or equipment data and providing materials, equipment, etc., fully in accordance with the Specifications.
3. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the Owner and the Engineer. This log should include the following items:
  - a. Submittal Description and Number assigned.
  - b. Date Submitted to Engineer.
  - c. Date Received Back from Engineer
  - d. Status of Submittal (Approved, Approved as Noted, Not Approved/Resubmit).
  - e. Date of Re-submittal and Return (as applicable).
  - f. Date Equipment Released for Fabrication/Delivery.
  - g. Projected Date of Fabrication.
  - h. Projected Date of Delivery to Site.
  - i. Status of O&M Manuals Submittal.

1.02 CONTRACTOR'S RESPONSIBILITY

- A. It is the responsibility of the Contractor to check all drawings, data and samples prepared before submitting them to the Engineer for review. Each and every copy of the Drawings and data shall bear Contractor's stamp showing that they have been so checked. Shop drawings and/or equipment data submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from

- requirements of the Contract Documents. If the Contractor takes exception to the specifications, the Contractor shall note the exception in the letter of transmittal to the Engineer.
- B. Determine and verify:
1. Field measurements.
  2. Field construction criteria.
  3. Catalog numbers and similar data.
  4. Conformance with Specifications.
- C. The Contractor shall furnish the Engineer a schedule of submittals with the expected dates for the submissions of shop drawings and/or equipment data and the expected time for fabrication and delivery. This schedule shall indicate those that are critical to the construction schedule.
- D. The Contractor shall not begin any of the work covered by a drawing, data, or a sample returned for correction until a revision or correction thereof has been reviewed and returned to him, by the Engineer, with approval.
- E. The Contractor shall submit to the Engineer all drawings and schedules sufficiently in advance of construction requirements to provide no less than thirty (30) calendar days for reviewing and approval/disapproval from the time the Engineer receives them.
- F. All submittals shall be accompanied with a transmittal letter prepared in duplicate containing the following information:
1. Date
  2. Project Title and Number
  3. Contractor's name and address
  4. The number of each Shop Drawings submitted.
  5. Notification of Deviations from Contract Documents.
  6. Submittal Log Number referencing the Specification Section Number.
- G. The Contractor shall submit electronic copies (PDF) of equipment or product data information and shop drawings.
- H. The Contractor shall be responsible for and bear all costs of damages which may result from the ordering of any material or from proceeding with any part of work prior to the completion of the review by Engineer of the necessary shop drawings and/or equipment data.
- I. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposed to supply both as

pertains to his own work and any work affected under other parts, headings, or divisions of drawings and specifications.

- J. The Contractor shall not use shop drawings as a means of proposing alternate items to demonstrate compliance with the Drawings and Specifications.

### 1.03 ENGINEER'S REVIEW OF SUBMITTALS

- A. The review by the Engineer of shop drawings, equipment data, and samples submitted by the Contractor will cover only general conformity to the Specifications, external connections, and dimensions which affect the installation. The Engineer's review and exceptions, if any, will not constitute an approval of dimensions, quantities, and details of the material, equipment, device, or item shown.
- B. The review of shop drawings, equipment data, schedules, and/or O&M data will be general, and shall not be construed:
  - 1. as permitting any departure from the Contract requirements;
  - 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
  - 3. as approving departures from details furnished by the Engineer, except as otherwise provided herein.
- C. If the drawings or schedules as submitted describe variations and show a departure from the Contract requirements which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.
- D. When reviewed by the Engineer, each of the submittals will be identified as having received such review being so stamped and dated. Submittals stamped "APPROVED AS NOTED" or "DISAPPROVED, "REVISE AND RESUBMIT" and with required corrections shown will be returned to the Contractor for correction and re-submittal.
- E. Re-submittals will be handled in the same manner as first submittals. On re-submittals the Contractor shall direct specific attention, in writing or on resubmitted shop drawings, to revisions other than the corrections requested by the Engineer on previous submissions. The Contractor shall address and make any corrections required by the Engineer.
- F. If the Contractor considers any correction indicated on the drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer.
- G. Shop drawings and other submittal data shall be reviewed by the Engineer for each original submittal and for the first re-submittal. Thereafter, review time for

subsequent re-submittals shall be charged to the Contractor in accordance with the terms of the Engineer's Agreement with the Owner.

- H. When the shop drawings and/or equipment data have been approved or approved as noted by the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.
- I. No partial submittals will be reviewed. Submittals not complete will be returned to the Contractor for re-submittal.
- J. All drawings, schematics, manufacturer's product data, certifications and other shop drawing submittals required by a system specification shall be submitted at one time as a package to facilitate interface checking.

#### 1.04 SHOP DRAWINGS AND/OR EQUIPMENT DATA

- A. Shop drawings shall be complete and detailed and shall consist of fabrication, erection, and setting drawings, manufacturer's scaled drawings, and wiring and control diagrams.
- B. Equipment data shall include manufacturer's catalog sheets, brochures, diagrams, illustrations and other standard descriptive data and shall be clearly marked to identify pertinent materials, products or models.
  - 1. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in his letter of transmittal. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility for executing the work in accordance with the Contract, even though such drawings have been reviewed.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01370  
SCHEDULE OF VALUES**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. Submit to the Engineer a Schedule of Values allocated to the various lump sum portions of the Work, at the Pre-Construction Conference, and as otherwise specified or requested to be submitted earlier as evidence of the Apparent Low Bidder's qualifications.
2. Upon request of the Engineer support the values with data which will substantiate their correctness. The data shall include, but not be limited to quantity of materials, all sub-elements of the activity, and their units of measure. The format of the pay application submitted by the Contractor shall be the similar format as the approved Schedule of Values.
3. The Schedule of Values shall establish the actual value for each activity of the Work to be completed taken from the approved Critical Path Method (CPM) Construction Schedule, and shall be used as the basis for the Contractor's Applications for Payment.

B. Related Requirements Described Elsewhere:

1. Conditions of the Construction Contract.

1.02 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Type schedule on 8-1/2 inch x 11 inch white paper. Contractor's standard forms and computer printouts may be considered for approval by the Engineer upon Contractor's request. Identify schedule with:

1. Title of project and location.
2. Owner and purchase order number.
3. Engineer and project number.
4. Name and address of Contractor.
5. Contract designation.
6. Date of submission.

B. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing item prices for progress payments during construction.



- C. Identify each line item with the number and the title of the respective section of the Specifications.
- D. For each major item of the Work, list sub-values of major products or operations under the major item.
- E. For the various portions of the Work:
  - 1. The amount for each item shall reflect a total installed cost including a directly proportional amount of the Contractor's overhead and profit.
  - 2. For items on which progress payments will be requested for stored materials, break down the value into:
    - a. The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials. Payment for materials shall be limited to the invoiced amount only.
    - b. The total installed value.
- F. Round off figures to nearest dollar amount.
- G. The sum of the costs of all items listed in the schedule shall equal the total Contract Price.
- H. For each item which has an installed value of more than \$15,000, provide a breakdown of costs to list major products or operations under each item.
- I. The form of the Schedule of Values shall parallel the form presented in Table 01370-1. As a minimum, the Contractor shall provide a contract value for all of the items listed in Table 01370-1. The Contractor may add additional items for convenience of pay request approvals.

#### 1.03 SUB-SCHEDULE OF UNIT MATERIAL VALUES

- A. Submit a separate schedule of unit prices for materials to be stored on site and for those materials incorporated into the Work for which progress payments will be requested.
- B. Format shall parallel that shown in Section 00846: Materials Stored On Site Form and Section 00845: Schedule of Values Form.
- C. The unit values for the materials shall be broken down into:
  - 1. Cost of the material, delivered and unloaded at the site, with taxes paid.
  - 2. Copies of paid invoices for component material shall be included with the payment request in which the material first appears.

- D. Only materials unique to the project may be billed when stored on site. Materials of standard use such as conduit, wire, small-diameter pipe, steel, etc., shall not be accepted for payment.
- E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

1.04 REVIEW AND RESUBMITTAL

- A. After review by Engineer, revise and resubmit Schedule of Values and Schedule of Unit Material Values as required.
- B. Resubmit revised schedules in same manner.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**TABLE 01370-1  
SAMPLE SCHEDULE OF VALUES**

	No. of <u>Units</u>
I. General Requirements	
- Mobilization/Demobilization	1
- Indemnification	1
- Bonds and Insurance	1
- Permitting	1
II. Site Improvements	
- Dewatering	1
- Excavation	1
- Backfill and Compaction	1
- Finish Grading	1
- Sodding	1
- Temporary Erosion Control	1
III. Hypochlorite Storage and Feed	
- Foundation	1
- Structure including Slab, Platform, Pedestals, Walls	1
- Metal Building	1
- Tanks	1
- Pumps	1

- Existing Pump Skid 1
  - Hypochlorite Piping 1
  - Potable Water Piping,  
Hose Racks, Shower 1
- IV. Yard Piping
- Hypochlorite Piping 1
  - Hydrant and Potable Water  
Distribution 1
- V. Electrical Improvements
- Electrical 1
- VI. Instrumentation and Control Improvements
- I&C, SCADA 1

**END OF SECTION**

**SECTION 01380  
CONSTRUCTION PHOTOGRAPHS**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. Scope of Work: The Contractor shall have a competent photographer take construction record photographs prior to start of work and periodically during the course of the Work.
- B. Related Requirements Described Elsewhere:
  - 1. General Requirements: Section 01000
  - 2. Summary of Project: Section 01010
  - 3. Project Record Documents and Survey: Section 01720

1.02 PHOTOGRAPHY REQUIRED

- A. Photographs taken in conformance with this Section shall be furnished to the Engineer with each pay request.
- B. Photographs shall be taken at each of the major stages of construction and as directed by the Engineer.
- C. Photographs may be taken by the Contractor's personnel but must be of professional quality as herein specified. Photographs which are deemed unsatisfactory will be rejected and retakes will be required.
- D. Views and Quantities Required:
  - 1. Six (6) digital photos of one (1) view of each activity as directed by the Resident Project Representative, up to a limit of ten activities photographed per month.
  - 2. Six (6) digital photos of five (5) views of overall Project site monthly, as directed by the Resident Project Representative.

1.03 COST OF PHOTOGRAPHY

- A. The Contractor shall pay costs for specified photography and prints. Parties requiring additional photography or prints will pay the photographer directly.

## **PART 2 - PRODUCTS**

### 2.01 PRINTS

- A. Full color.
- B. Finish: Smooth surface, glossy.
- C. Minimum Size: 4 in x 6 in for all views.
- D. Paper Weight: Single weight, neutral, image tone, white base.
- E. Mounting: In plastic sheets in loose leaf, three ring binders.
- F. Provide a CD with electronic photo files. Furnish a file index that lists photo no. or file name and description of view.

### 2.02 IDENTIFICATION

- A. Identify each print on back.
  - 1. Name of project.
  - 2. Phase.
  - 3. Name of contractor.
  - 4. Description of view/orientation.
  - 5. Time and date of exposure.
  - 6. Name and address of photographer.
  - 7. Photographer's numbered identification of exposure.

## **PART 3 - EXECUTION**

### 3.01 TECHNIQUE

- A. Factual Presentation.
- B. Correct exposure and focus.
  - 1. High resolution and sharpness
  - 2. Maximum depth-of-field
  - 3. Minimum distortion

### 3.02 VIEWS REQUIRED

- A. Photograph from locations to adequately illustrate condition of construction and state of progress.
  - 1. At successive periods of photography, take at least one photograph from the same overall view as previously photographed.
  - 2. Consult with the Engineer at each period of photography for instructions concerning views required.

### 3.03 DELIVERY OF PRINTS

- A. Deliver prints and/or CDs monthly to accompany each Application for Payment.
- B. Distribution of construction prints as soon as processed is anticipated to be as follows:
  - 1. Owner (two (2) sets)
  - 2. Engineer (two (2) sets)
  - 3. Project record file (one (1) set to be stored by Contractor until the end of the project which shall be delivered with Project Record Documents as specified in Section 01720).
  - 4. Contractor (one (1) set)

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01410**  
**TESTING AND TESTING LABORATORY SERVICES**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. Owner will employ, and pay for services of an Independent Testing Laboratory to perform testing specifically indicated on the Contract Documents or specified in the Specifications and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents.
2. Contractor shall cooperate with the laboratory to facilitate the execution of its required services.

B. Related Requirements Described Elsewhere:

1. Conditions of the Contract.
2. Respective section of the Specifications: Certification of products.
3. Each Specification section listed: Laboratory tests required, and standards for testing.

C. The following schedule defines the responsibilities of various tests.



Test	Notes	Paid for By
Soil Compaction	Pipe Work: every 300 ft. at each lift of compaction minimum. Beneath Structures: each 500 SF each lift of compaction minimum.	Owner
Pressure	As specified in Section 15044.	Contractor
Bacteriological	As required by local and state agencies.	Owner
Concrete	Slump test each delivery and compression test five cylinders every 50 C.Y. minimum.	Owner

- D. Additional Tests: In the event that first test samples do not meet the applicable material specification, the Contractor shall take measures to conform the material and equipment to the Specifications. All subsequent tests required to show compliance with the Specifications shall be paid for by the Contractor.

#### 1.02 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with Owner's personnel and laboratory personnel. Provide access to Work and manufacturer's operations.
- B. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.
- C. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacturer or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. The Engineer may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the Owner shall be allowed on account of such testing and certification.
- D. Furnish incidental labor and facilities:

1. To provide access to Work to be tested.
  2. To facilitate inspections and tests.
- E. Notify Owner a minimum of three (3) working days in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01500  
TEMPORARY FACILITIES**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Provide temporary facilities which include but are not limited to the following:
1. Owner/Engineer's field office
  2. Temporary telephone/wireless internet service
  3. Temporary electrical service
  4. Temporary water service
  5. Temporary sanitary facilities
  6. Contractor's storage facilities
  7. Temporary parking
  8. Temporary security lighting

1.02 TEMPORARY TELEPHONE/WIRELESS INTERNET SERVICE

- A. Temporary telephone and wireless internet service shall be provided throughout the construction period for use by the Owner, Engineer, and the Contractor.
- B. Separate lines shall be provided for telephones, fax machines, and internet connections.

1.03 TEMPORARY ELECTRICAL SERVICE

- A. Temporary electrical service shall be provided throughout the construction period.
- B. Contractor shall coordinate with the local power supplier to obtain, install and maintain the service.
- C. Adequate power shall be provided for the following:
1. Tools and equipment used in the construction work.
  2. Field offices
- D. Provide 120/240 volt, single phase, 60 hertz service to the project site. The use of portable generators is allowed but any connections to the main power supply must be in accordance with the local power supplier rules.

- E. Strict supervision of the use of the temporary services shall be provide to ensure conformance with applicable codes, to ensure that safe practices are followed, and to prevent the abuse of the services.
- F. Costs of the installation and usage of the temporary service shall be paid by the Contractor.
- G. The temporary service shall be in accordance with all applicable OSHA, NFPA , state and local codes.

#### 1.04 TEMPORARY WATER SERVICE

- A. Temporary water service shall be provided throughout the construction period.
- B. Contractor shall coordinate with the Owner to obtain, install, and maintain the service.
- C. Adequate water shall be provided for the following:
  - 1. Construction purposes.
  - 2. Testing purposes
  - 3. Cleaning purposes
  - 4. Sanitary purposes
- D. Proper backflow prevention shall be provided at the point of connection to the public water system and at other connections between potable and non-potable water lines.
- E. Strict supervision of the use of the temporary services shall be provide to ensure conformance with applicable codes, to ensure that safe practices are followed, and to prevent the abuse of the services.
- F. Costs of the installation and usage of the temporary service shall be paid by the Contractor.
- G. The temporary service shall be in accordance with all applicable OSHA, state and local codes.

#### 1.05 TEMPORARY SANITARY FACILITIES

- A. Temporary sanitary facilities shall be provided throughout the construction period. Facilities shall consist of portable toilets.
- B. Contractor shall coordinate with a service to obtain and maintain the facilities.
- C. Adequate facilities shall be provided for the following:
  - 1. Construction workers.

2. Owner/Engineer
  - D. Strict supervision of the use of the temporary facilities shall be provided to ensure conformance with applicable codes, to ensure that safe practices are followed, and to prevent the abuse of the facilities.
  - E. Costs of the installation and maintenance of the temporary facilities shall be paid by the Contractor.
  - F. The temporary facilities shall be in accordance with all applicable OSHA, state and local codes.

## **PART 2 - MATERIAL AND EQUIPMENT**

### 2.01 GENERAL

- A. The Contractor shall supply and maintain all temporary structures and equipment.
- B. The temporary structures shall be clean and in good condition.

### 2.02 CONTRACTOR'S STORAGE FACILITIES

- A. Lockable storage facilities shall be provided for storage of all equipment and sensitive materials. It shall be the Contractor's responsibility to secure and protect all equipment and materials from damage and theft.

### 2.03 TEMPORARY PARKING

- A. Provide a gravel parking area, at a location approved by the Engineer, for the Contractor's employees, the Owner's and Engineer's representatives, and visitors. Personal vehicles will be restricted from the work area. Provide room for parking at the Contractor's trailer for at least eight (8) vehicles and at the Owner/Engineer's field office for at least four (4) vehicles.

### 2.04 SECURITY LIGHTING

- A. Provide pole mounted security lights for the parking area at the Contractor and Owner/Engineer's office areas. Maintain lighting on a photocell.

## **PART 3 - EXECUTION**

### 3.01 PREPARATION

- A. The site shall be properly prepared for the setting of all temporary structures the installation of all temporary facilities.

### 3.02 INSTALLATION

- A. Locate water piping and outlets convenient to work stations and avoid interference with traffic and work areas, materials handling equipment, and storage areas. When necessary to maintain pressure, provide temporary pumps, tanks, etc.
- B. Electrical service and distribution may be overhead or underground. Locate to avoid interference with traffic and work areas, cranes, material handling equipment, and storage areas.
- C. Set portable toilets level and anchor to prevent dislocation or tipping over. Service as often as necessary to prevent accumulation of wastes, and creation of unsanitary conditions.

### 3.03 REMOVAL OF TEMPORARY FACILITIES

- A. Completely remove temporary structures, facilities, materials and equipment upon completion of construction.
- B. Clean, and repair damage caused by installation and restore areas to specified or original condition.

**END OF SECTION**

**SECTION 01505  
MOBILIZATION**

**PART 1 - GENERAL**

1.01 DEFINITION AND SCOPE

- A. Mobilization shall include the obtaining of all permits, insurance, and bonds; moving onto the site of all equipment; temporary buildings and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to the following:
1. Move onto the site all Contractor's equipment required for the first month's operations.
  2. Install temporary construction power, wiring and lighting facilities.
  3. Establish fire protection plan and safety program.
  4. Secure construction water supply.
  5. Provide on-site sanitary facilities and potable water facilities as specified.
  6. Arrange for and erect Contractor's work and storage yard and employee's parking facilities.
  7. Submit all required insurance certificates and bonds.
  8. Obtain all required permits.
  9. Post all OSHA, EPA, Department of Labor and all other required notices.
  10. Have Contractor's superintendent at the job site full time.
  11. Submit a detailed construction CPM schedule acceptable to the Engineer as specified.
  12. Submit a schedule of values of the work.
  13. Submit a schedule of submittals.

1.02 DEMOBILIZATION

- A. Demobilization is the timely and proper removal of all Contractor owned material, or equipment, from the jobsite and the proper restoration or completion of work necessary to bring the site into full compliance with the contract documents.



**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01580  
PROJECT IDENTIFICATION AND SIGNS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work:
  - 1. Furnish, install and maintain project signs.
  - 2. Remove signs on completion of construction.
  - 3. Allow no other signs to be displayed.
- B. Related Requirements Described Elsewhere:
  - 1. Summary of Project: Section 01010.
  - 2. Painting: Section 09900.

1.02 PROJECT SIGNS

- A. One (1) painted sign with lettering, size, color and construction in accordance with Orange County requirements.
- B. Erect on the worksite at a location of high public visibility, as approved by the Engineer and the Owner.
- C. Information:
  - 1. Project Sign:
    - a. Owner title and logo.
    - b. Project name.
    - c. Contractor.
    - d. Engineer.

1.03 INFORMATIONAL SIGNS

- A. Painted signs with painted lettering, or standard products.
  - 1. Size of signs and lettering: As required by the Owner, or as appropriate to usage.
  - 2. Color: As required by the Owner, otherwise of uniform colors throughout Project.
- B. Erect at appropriate locations to provide required information.

1.04 QUALITY ASSURANCE

- A. Sign Painter: Professional experience in type of work required.
- B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

1.05 SUBMITTALS

- A. An 11 inch by 17 inch sketch of the project sign shall be submitted to the Engineer for approval prior to final preparation of the project sign.

**PART 2 - PRODUCTS**

2.01 SIGN MATERIALS

- A. Structure and Framing: May be new or used, wood or metal, in sound condition, structurally adequate and suitable for specified finish.
- B. Sign Surfaces: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.
  - 1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.
- C. Rough Hardware: Galvanized.
- D. Paint: Exterior quality, as specified in Section 09900: Painting.

**PART 3 - EXECUTION**

3.01 PROJECT IDENTIFICATION SIGNS

- A. Paint exposed surface of supports, framing and surface material; one coat of primer and one coat of exterior paint.
- B. Paint graphics in styles, sizes, and colors selected.

3.02 MAINTENANCE

- A. Maintain signs and supports in a neat, clean condition; repair damages to structures, framing or signs.

3.03 REMOVAL

- A. Remove signs, framing, supports and foundations at completion of project.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01600**  
**MATERIAL AND EQUIPMENT**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Material and equipment incorporated into the Work:
1. Conform to applicable specifications and standards.
  2. Comply with size, make, type and quality specified, or as specifically approved in writing by Engineer.
  3. Manufactured and fabricated products:
    - a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
    - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
    - c. Two or more items of the same kind shall be identical, by the same manufacturer.
    - d. Products shall be suitable for service conditions.
    - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
  4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.
- B. Related Work Described Elsewhere:
1. General Conditions and Requirements of the Contract
  2. Submittals: Section 01340

1.02 APPROVAL OF MATERIALS

- A. Only new materials and equipment shall be incorporated in the work. All materials and equipment furnished by Contractor shall be subject to the inspection and approval of Engineer. No material shall be delivered to the site without prior approval of Engineer.
- B. The Contractor shall submit to Engineer, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable Engineer to identify the particular product to form an opinion as to its conformity to the specifications.

- C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by Contractor. If Engineer requires, either prior to beginning or during progress of the work, Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the specifications. Such samples shall be furnished, stored, packed and shipped as directed at Contractor's expense. Except as otherwise noted, Contractor will make arrangements for and pay for the tests.
- D. Contractor shall submit data and samples sufficiently early to permit consideration and approval before materials are necessary for incorporation in the work. Any delay of approval resulting from Contractor's failure to submit samples or data promptly shall not be used as a basis of claim against Owner or Engineer.
- E. In order to demonstrate the proficiency of workers or to facilitate the choice among several textures, types, finishes and surfaces, Contractor shall provide such samples of workmanship or finish as may be required.
- F. The materials and equipment used on the work shall correspond to the approved samples or other data.

#### 1.03 SUBSTITUTIONS AND PRODUCT OPTIONS

- A. The substitution requirements of this Section are in addition to the requirements of the General Conditions and Special Conditions.
- B. The intent of these Specifications is to provide Owner with a quality facility without discouraging competitive bidding. Substitutions may be submitted and will be evaluated as specified herein.
- C. For products specified only by reference standards, performance and descriptive methods, without naming manufacturer's products, the Contractor may provide the products of any manufacturer complying with the Contract Documents, subject to the review of product data by Engineer as specified herein.
- D. For products specified by naming a manufacturer's product followed by the words "or equal" or "or approved equal", the Contractor may provide any of the named products. He may substitute a product by another manufacturer as an equal only after review by the Engineer and Owner's Representative as specified herein. In all cases, any product provided must comply with all of the specified requirements.

#### 1.04 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including five copies to Engineer.

- B. Maintain one set of complete instructions at the job site during installation and until completion.
- C. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.
  - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
  - 2. Do not proceed with work without clear instructions.
- D. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

#### 1.05 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at the site.
  - 1. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
  - 2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.
- B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

#### 1.06 STORAGE AND PROTECTION

- A. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.
  - 1. Store products subject to damage by the elements in weather tight enclosures.
  - 2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.
  - 3. Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
  - 4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- B. All materials and equipment to be incorporated in the work shall be handled and stored by Contractor before, during and after shipment in a manner to prevent



warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage of any kind whatsoever to the material or equipment.

- C. Cement, sand and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural and miscellaneous steel, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical.
- D. All materials which, in the opinion of Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the work, and Contractor shall receive no compensation for the damaged material or its removal.
- E. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.
- F. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.
- G. The Contractor shall be responsible for all material, equipment and supplies sold and delivered to Owner under this Contract until final inspection of the work and acceptance thereof by Owner. In the event any such material, equipment and supplies are lost, stolen, damaged or destroyed prior to final inspection and acceptance, Contractor shall replace same without additional cost to Owner.
- H. Should Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven days after written notice to do so has been given, Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering and any other costs associated with making the necessary corrections.

#### 1.07 STORAGE AND HANDLING OF EQUIPMENT ON SITE

- A. Special attention shall be given to the storage and handling of materials on site. As a minimum, the procedure outlined below shall be followed:
  - 1. Materials shall not be shipped until approved by the Engineer. The intent of this requirement is to avoid unnecessary delivery of unapproved materials and to reduce on-site storage time prior to installation and/or operation. Under no circumstances shall materials be delivered to the site more than one month prior to installation without written authorization from the Engineer.

Materials shipped to the site shall be stored in accordance with Paragraph 1.06, herein.

2. Manufacturer's storage instructions shall be carefully studied by Contractor and reviewed with Engineer by him. These instructions shall be carefully followed and a written record of this kept by the Contractor.

1.08 WARRANTY

- A. For all major pieces of material, submit a warranty from the material manufacturer as specified in Section 01740. The manufacturer's warranty period shall be concurrent with the Contractor's for a minimum of one (1) year after the Final Acceptance by the Engineer and the Owner.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01650  
START-UP AND DEMONSTRATION**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Provide material, personnel, and equipment as needed and as specified herein to perform the required start-up and demonstration tests.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

3.01 PRELIMINARY FIELD TESTS

- A. Start-up Certification: Prior to system start-up, the Contractor shall successfully complete all the field testing required of the individual components of the work. Submit one electronic copy of the Pump Station Start-Up Form for each individual component, signed by Contractor, Construction Observation and the Water Reclamation Division Representative. A sample Pump Station Start-Up Form is provided at the end of this section. Copies of all test reports shall be provided within the respective copies of the Operation and Maintenance Manual. This form shall be completed and submitted before Instruction in Operation to Owner or a request for initiating any final inspection(s).
- B. The Contractor shall demonstrate to the Owner's Representative that all temporary jumpers and/or bypasses have been removed and that all of the components are operating under their own controls as designated.
- C. Coordinate start up activities with the Owner's operating personnel at the pump station site and with the Engineer prior to commencing system start-up.

3.02 START-UP TESTS

- A. Confirm that all equipment is properly energized, that the valves are set to their normal operating condition and that the flow path through the new work is unobstructed.
- B. Start-up and training shall be initiated in accordance with and with the use of the operation and maintenance manuals.

- C. The start-up tests will be conducted for section of the project as they become ready for substantial completion. Each pump skid shall be tested individually. Each skid will be tested as indicated in specification Section 11345 and as necessary to demonstrate full functioning of all alarms, signals and pumps as a complete system. The Contractor shall submit a preliminary testing plan prior to testing each pumping skid system. If the system fails to operate successfully, or if the start-up is interrupted due to other contracts, the problems will be corrected and the test will start over. The party causing the interruption will be subject to the assessment of actual damages due to delay. During the start-up tests, instruct designated operating personnel in the function and operation of the Work.
- D. The Contractor shall coordinate with the Owner for any adjustments desired or operational problems requiring debugging.
- E. The Contractor shall make adjustments as necessary to correct any deficiencies.

### 3.03 DEMONSTRATION TESTS

- A. After all Work components have been constructed, field tested and started-up in accordance with the individual specifications and manufacturer requirements, perform the Demonstration Tests in the presence of the Engineer and the Owner. The demonstration shall be held upon completion of all systems at a date to be agreed upon in writing by the Owner or his representative.
- B. During the demonstration test, operate the Work and cause various operational circumstances to occur. As a minimum, these circumstances will include average and peak flows, random equipment failures, drawdown tests and alarm conditions. Demonstrate the essential features of the equipment and its relationship to other equipment. Prior to the demonstration test, the Contractor shall submit two (2) copies of a detailed schedule of operational circumstances to describe the proposed test procedures for approval of completeness. These approved procedures will then be used as the agenda at the demonstration. Coordination of the test schedule will be accomplished through the Engineer.
- C. The demonstration test procedures shall follow the example test procedure form provided at the end of this section. Provide similar test procedure forms for each section of the work to cover all aspects and features specified. The test procedures may be broken down into specific areas as follows:
  - 1. Skid Pumps and Instrumentation Testing
  - 2. Chemical Tanks and Instrumentation Testing
  - 3. Chemical Feed Piping Testing
  - 4. Pressure Pipe Pressure Testing
- D. Acceptability of the Work's performance will be based on the Work performing as specified, under these actual and simulated operating conditions and providing

- wastewater pump station improvements as defined in the Contract Documents. The intent of the demonstration tests is for the Contractor to demonstrate to the Owner and the Engineer that the Work will function as a complete and operable system under normal as well as emergency operating conditions and is ready for acceptance.
- E. Demonstrate the essential features of the whole system as it applies to the Work, including the mechanical equipment, piping, structures, finishes, controls, instrumentation, and power distribution. Use the approved procedures and circumstances to demonstrate the system. Any minor deficiencies found shall be noted and included on a punch list attached to the Certificate of Completed Demonstration. The system shall be demonstrated only once, after completion of start-up tests. If circumstances arise that interrupt the test procedures (such as weather, unforeseen process problems, or problems caused by the Contractor whether or not the problems are the fault of the Contractor, etc.), then the test shall be terminated and rescheduled to a later date after the problem is corrected. The test shall be run in its entirety if so directed by the Engineer.
- F. Certificate of Completed Demonstration: Submit one (1) electronic copy of the Facility Performance Demonstration Certification Form for the Work, signed by the Contractor and the Engineer and insert one copy in each Operation and Maintenance Manual. A sample Facility Performance Demonstration Certification Form is provided at the end of this section.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**FACILITY PERFORMANCE DEMONSTRATION CERTIFICATION FORM**

**OWNER:** \_\_\_\_\_ **PROJECT:** \_\_\_\_\_

*Unit Processes Description (List unit processes involved in facility startup):*

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

*Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):*

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:**

**Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_, 20\_\_\_\_

**Engineer:** \_\_\_\_\_ **Date:** \_\_\_\_\_, 20\_\_\_\_  
(Authorized Signature)

**END OF SECTION**



**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01700  
CONTRACT CLOSEOUT**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Comply with requirements stated in the General Conditions and Requirements of the Contract and in specifications for administrative procedures in closing out the Work.

1.02 SUBSTANTIAL COMPLETION

- A. The work may not be considered substantially complete unless the punch list items that remain, as identified by the Engineer and Owner, can be completed within thirty (30) days. All painting, finishes, fencing, cleanup, final grading, grassing and landscape planting shall have been completed and ready for inspection before substantial completion is given. Also, all building occupancy certificates will need to have been obtained. After (or concurrent with) the Demonstration Tests, with any minor deficiencies noted, the Contractor wishing to consider the Work substantially complete, shall have work completed as follows and submit to the Engineer:

1. A written notice that the Work is substantially complete.
2. A list of items to be completed or corrected and explanations thereof.
3. All Operations and Maintenance manuals have been submitted and approved in accordance with the Contract Documents.
4. All equipment has been checked-out by the equipment manufacturer and Certificates of Manufacturer's Check-Out have been submitted in accordance with the Contract Documents.
5. All start-up and demonstration testing completed and Certificates of Completed Demonstration submitted are in accordance with the Contract Documents.
6. Project Record Documents are complete and have been submitted and reviewed in accordance with the Contract Documents.
7. The pump skids are fully-operational and are able to pump the required flow and head conditions. Additionally, the pump skids can be started up and operated in automatic mode.
8. All training of Owner's personnel is completed.
9. All areas to be used and occupied are safe, operable in automatic and complete.

10. All deficiencies noted on inspection reports or non-conformances are corrected or the correction plan is approved.
  11. All building inspections shall have been performed and passed by the local code officials.
- B. Within a reasonable time after receipt of such notice, the Engineer will make an inspection, if necessary, to determine the status of completion.
- C. Should Engineer determine that the Work is not substantially complete:
1. The Engineer will promptly notify Contractor in writing, giving the reasons therefore.
  2. Contractor shall remedy the deficiencies in the Work and send a second written notice of substantial completion to Engineer.
  3. Engineer will re-inspect the Work.
- D. When Engineer finds that the Work is substantially complete, he will:
1. Prepare a tentative Certificate of Substantial Completion, with a tentative list of items to be completed or corrected before final inspection.
  2. After consideration of any objections made by the Owner as provided in the General Conditions of the Contract, the Engineer will execute the Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

#### 1.03 FINAL INSPECTION AFTER COMPLETION

- A. When Contractor considers the Work is complete with all minor deficiencies completed or corrected, he shall submit written certification that:
1. Contract Document requirements have been met.
  2. Work has been inspected for compliance with Contract Documents.
  3. Work has been completed in accordance with Contract Documents.
  4. Equipment and systems have been tested in the presence of Owner's representative and are operational.
  5. All minor deficiencies have been corrected or completed and the Work is ready for final inspection.
  6. All operation and maintenance manuals have been submitted.
  7. Project record documents are complete and submitted.
  8. Transfer of all spares and expendables has been made to the Owner with a full accounting of the quantities and amounts due.
- B. Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

- C. Should Engineer consider that the Work is incomplete or defective:
  - 1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
  - 2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to Engineer that the Work is complete.
  - 3. Engineer will re-inspect the Work.
- D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.04 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

- A. Evidence of compliance with requirements of governing authorities.
- B. Project Record Documents and Survey: To requirements of Section 01720.
- C. Operating and Maintenance Data: To requirements of Section 01730.
- D. Spare Parts and Maintenance Materials: To requirements of Technical Sections of the Specifications.
- E. Evidence of Payment and Release of Liens: To requirements of General and Special Conditions.
- F. Certificate of Insurance for Products and Completed Operations.
- G. Evidence of all Certifications of Warranties and Bonds.

1.05 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01710  
CLEANING**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Execute cleaning, during progress of the Work, and at completion of the Work, as required by this section and the General Conditions.
- B. Related Work Described Elsewhere:
  - 1. General Conditions and Requirements of the Contract.
  - 2. Each Specification Section: Cleaning for specific Products or Work.

1.02 DISPOSAL REQUIREMENTS

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazard to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

**PART 3 - EXECUTION**

3.01 DURING CONSTRUCTION

- A. Execute daily cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.

- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

### 3.02 DUST CONTROL

- A. Construction techniques that minimize the production and distribution of dust shall be used.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

### 3.03 FINAL CLEANING

- A. The Contractor shall wash down and vacuum out the containment area.
- B. Prior to final completion, or Owner occupancy, the Engineer shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire Work is clean.

**END OF SECTION**

**SECTION 01720  
PROJECT RECORD DOCUMENTS AND SURVEY**

**PART 1 - GENERAL**

1.01 PURPOSE AND DESCRIPTION OF WORK

- A. The purpose of the Project Record Documents is to provide the County with factual information regarding all aspects of the Work, both concealed and visible, to enable future location, identification and modification of the Work without lengthy and expensive site measurement, investigation or examination.
- B. Provide professional surveying and mapping work required for the execution of the contract, including verification of existing survey data, construction layout, and production of the As-Built Drawings. This Work shall be performed by a Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.
- C. The location of the constructed improvements as depicted in the contract drawings is required. To verify the As-Built Drawing accuracies and to insure the Work was constructed in conformance with the contract drawings, the following survey documents are required to be certified by the Surveyor.
  - 1. As-Built Asset Attribute Data Table,
  - 2. Gravity Main Table,
  - 3. Pipe Deflection Table,
  - 4. Boundary Survey of Sodium Hypochlorite Storage Improvements and Survey Map Report and
  - 5. Boundary Survey and Survey Map Report for any easements that have constructed pipes within and monuments that were replaced.

1.02 DEFINITIONS

- A. Except where specific definitions are used within a specific section, the following terms, phrases, words and their derivation shall have the meaning given herein when consistent with the context in which they are used. Words used in the present tense include the future tense, words in the plural number include the singular number and words in the singular number include the plural number. The word "shall" is mandatory, and the word "may" is permissive.
  - 1. **As-Built Drawings:** Drawings prepared by the Contractor's Surveyor shall depict the actual location of installed utilities for the completed WORK in a full size hard copy and an electronic AutoCAD file (dwg) format.
  - 2. **Record Drawings:** Drawings, prepared by prepared and certified by the County's Consultant Engineer, shall be a compiled representation of the constructed project, a listing of the sources and the basis of information used



in the preparation of the “record drawings”, the constructed project meets the Engineer’s design intent and note the material deviations from the design documents, and the accuracy of the location information is based upon the Contractor’s surveyor data supplied in the tables (As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection).

3. **Boundary Survey:** Boundary survey, map and report certified by a Surveyor shall be provided that meets the requirements of Chapter 61G17-6 ‘Minimum Technical Standards’, FAC.
4. **Surveyor:** Contractor’s Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.
5. **Survey Map Report:** As a minimum the Survey Map Report shall identify any corners that had to be reset, measurements and computations made, sodium hypochlorite storage improvements boundary issues, and accuracies obtained.

### 1.03 QUALIFICATIONS OF THE SURVEYOR

- A. The Surveyor, who is proposed by the Contractor to provide services for the Project, is subject to the approval of the County. Prior to any services being performed, the Contractor shall submit the name and address of any proposed Surveyor and a written acknowledgement from the Surveyor stating that he has the hardware, software and adequate scope of services in his agreement with the Contractor to fully comply with the requirements of this specification. These submittals shall be provided to the County prior to Notice to Proceed. It is recommended that the Surveyor attend the Preconstruction meeting. Any Surveyor, who has not previously performed work for the County in the past, shall attend the Preconstruction meeting.

### 1.04 RELATED REQUIREMENTS

- A. All General Conditions, Supplements to the General Conditions, and any Addenda issued by the County are a part of this Section in the same manner as if fully written herein, and shall govern the Work of this Section, except where more stringent articles or requirements are stipulated, then they shall govern this Section.
- B. The Contract Documents are complementary and what is required by anyone shall be as binding as if required by all.
- C. Other requirements affecting Record Documents may appear in pertinent other sections of these specifications.

### 1.05 QUALITY ASSURANCE

- A. Delegate the responsibility for maintenance of the Record Documents to one person on the Contractor’s staff as approved by the County.
- B. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of specifications and each sheet of drawings and other documents where such entry is required to show progress and changes properly.

- C. Make entries within 24-hours after receipt of information has occurred.
- D. Survey documents shall comply with the minimum technical standards of Chapter 61G17-6 of the Florida Administrative Code (FAC) and Table 01720-1 Minimum Survey Accuracies specified in, whichever are more stringent. Asset attribute data shall be signed, sealed and dated by the Surveyor. All coordinates shall be geographically registered in the Florida State Plan Coordinate System using the contract drawings control points for horizontal and vertical controls.

**Table 01720-1  
Minimum Survey Accuracies**

Asset/Location	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: horizontal center and vertical top, unless otherwise specified
Bench Marks	N/A	0.01	Point
Horizontal Control	0.01	N/A	Point
Easements and Tracts	*	N/A	Survey Monuments
Civil Site, Topo and Foundation Drawings	0.1	0.01	All
Hydrants	0.01	N/A	Operating Nut
Blow off Valves	0.01	N/A	Valve Enclosure
Air Release Valves	0.01	N/A	Valve Enclosure
Master Meters	0.01	N/A	Register
Meter Box	0.01	N/A	Top of Meter Box
Clean-out	0.01	N/A	Top of Clean-out
Pump skids	0.01	0.01	Top Center of pump and Pipe Inverts
Manholes	0.01	0.1	Top Center of Cover
Manhole	N/A	0.01	Pipe Inverts
System Valves	0.01	0.1	Operating Nut and Valve Body
Fittings	0.01	0.1	Top of Fitting and Ground
Piping at 100' max intervals	0.01	0.1	Top of Pipe and Ground
Restrained Pipe	0.01	N/A	Limits
Connections	0.01	0.1	Pipe Invert
Bore & Jack Casing	0.01	0.1	Top of Casing at Limits of Casing

Existing Utilities**	0.01	0.1	Conflicts
----------------------	------	-----	-----------

\* Shall conform to the requirements of the “Chapter 61G17-6, ‘Minimum Technical Standards’, FAC”, certified by a Surveyor.

\*\* Existing utilities including but not limited to water, wastewater, reclaimed water, storm, fiber optic cable, electric, gas and structures within the limits of construction.

#### 1.06 SUBMITTALS

- A. Comply with pertinent provisions for the timely submittal requirements under this article and specification section.
- B. Prior to submitting a monthly payment application, the Contractor’s progressive As-Built Drawings and tables (As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection) shall be acceptable to the County.
- C. Progressive As-Built Drawings which will indicate the horizontal and vertical locations of all current constructed improvements with sufficient information and notes to easily determine if the improvements were constructed in conformance with the Contract Documents. The progressive As-Built Drawings shall include a Surveyor’s certified statement regarding the constructed improvements being within the specified accuracies or if not indicating the variances, as described in Table 01720-1 Minimum Survey Accuracies. The Contractor shall also submit the following updated monthly tables certified by the Surveyor:
- D. Prior to submitting a request for final payment or the County issuing a Certificate of Completion for the Work, the Contractor shall submit the final Record Documents to the County for approval. Retainage funds will be withheld at the County’s discretion based on the quality and accuracy of the final Record Documents.

#### 1.07 RECORD DOCUMENTS AT SITE

- A. Maintain at the site and always available for County’s use one record copy of:
  1. Construction Contract, Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.
  2. Change Orders, Verbal Orders, and other modifications to Contract.
  3. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).
  4. Accepted Shop Drawings, Samples, product data, substitution and “or-equal” requests.
  5. Field test records, inspection certificates, manufacturer certificates and construction photographs.
  6. Progressive As-Built Drawings
  7. Current Surveyor’s tables for the As-Built Assets Attribute Data, pipe deflection data, and gravity main data.

- B. Maintain the documents in an organized, clean, dry, legible condition and completely protected from deterioration and from loss and damage until completion of the Work, transfer of all record data to the final Record Documents and for submittal to the County.

## **PART 2 - PRODUCTS**

### **2.01 AS-BUILT DRAWINGS**

- A. Maintain the electronic As-Built Drawings to accurately record progress of Work and change orders throughout the duration of the Contract.
- B. Date all entries. Enter RFI No., Change Order No., etc. when applicable.
- C. Call attention to the entry by highlighting with a “cloud” drawn around the area affected.
- D. In the event of overlapping changes, use different colors for entries of the overlapping changes.
- E. Design call-outs shall have a thin strike line through the design call-out and all As-Built information must be labeled (or abbreviated “AB”) and be shown in a bolder text that is completely legible.
- F. Make entries in the pertinent other documents while coordinating with the Engineer and the County for validity.
- G. Entries shall consist of graphical representations, plan view and profiles, written comments, dimensions, State Plane Coordinates, details and any other information as required to document field and other changes of the actual Work completed. As a minimum, make entries to also record:
  - 1. Depths of various elements of foundation in relation to finish floor datum and State Plane Coordinates and elevations.
  - 2. Plan view and profile drawings: State Plane coordinates and elevations or depths for all assets shown in the Asset Attribute Data Table on each drawing if the fittings, valves, appurtenances, etc. are shown on that drawing sheet.
  - 3. When electrical boxes, or underground conduits and plumbing are involved as part of the Work, record true elevations and locations, dimensions between boxes.
  - 4. Actually installed pipe or other Work materials, class, pressure rating, diameter, size, specifications, etc. Similar information for other encountered underground utilities, not installed by Contractor, their owner and actual location if different than shown in the Contract Documents.
  - 5. Details, not on original contract Drawings, as needed to show the actual location of the Work completed in a manner that allows the County to find it in the future.

6. The Contractor shall mark all arrangements of conduits, circuits, piping, ducts and similar items shown schematically on the construction documents and show on the As-Built Drawings the actual horizontal and vertical alignments and locations.
7. Major architectural and structural changes including relocation of doors, windows, etc. Architectural schedule changes according to contractor's records and shop drawings.

## 2.02 RECORD DOCUMENTS

- A. A full size, two (2) hard copy set of the final Record Documents and shall include all of the documents described below under this subsection 2.02.
- B. The following documents shall be signed and sealed by the Surveyor:
  1. As-Built Asset Attribute Data Table (see Table 1720-2 for an example).
  2. Boundary Survey of sodium hypochlorite storage and improvements and Survey Map Report
  3. Survey and Survey Map Report for the location of constructed pipes within any easements and right-of-way. As a minimum the Survey Map Report shall identify or describe the locations where the pipe centerline was constructed within three feet of the easement or right-of-way boundary, where the pipe was constructed outside the easement or right-of-way boundary, any corners that had to be reset, measurements and computations made, sodium hypochlorite storage and improvements boundary issues, and accuracies obtained. Survey map report shall be dated after the Work within the right-of-ways or easements have been completed.
  4. Gravity Main Table
  5. Pipe Deflection Table (see Table 1720-3 for an example). *An electronic blank table will be supplied by the County.*
- C. Digital Set of the final Record Documents including but not limited to:
  1. Scanned digital copies of the final As-Built Drawings.
  2. Electronic Survey documents electronically sealed by the Surveyor.
  3. Final Record Documents information.
  4. Digital As-Built Drawing in the Engineer's current version of AutoCAD file (dwg) format for the Contract Drawings, updated to match the final Record Drawing information.
- D. Hypochlorite Storage Improvements site Boundary Survey and Map Report.
- E. New Boundary Survey to re-establish easement corners, right-of-way monuments, or sodium hypochlorite storage and improvements site corners with monuments if destroyed by the Work.

- F. Scanned Documents: Scan the Survey Documents and other Record Documents reflecting changes from the Bid Documents.
- G. The scanned As-Built drawing sets shall be complete and include the title sheet, plan/profile sheets, cross-sections, and details. Each individual sheet contained in the printed set of the As-Built Drawings shall be included in the electronic drawings, with each sheet being converted into an individual tif (tagged image file). The plan sheets shall be scanned in tif format Group 4 at 400 dpi resolution to maintain legibility of each drawing. Then, the tif images shall be embedded into a single pdf (Adobe Acrobat) file representing the complete plan set. Review all Record Documents to ensure a complete record of the project.
- H. Provide an encompassing digital AutoCAD file that includes all the information of the As-Built Drawings and any other graphical information in the As-Built Drawings. It shall include the overall Work, utility system layout and associated parcel boundaries and easements. Feature point, line and polygon information for new or altered Work and all accompanying geodetic control and survey data shall be included. The surveyor's certified as-built asset attribute data shall be added to the As-Built Drawings and Surveyor shall electronically seal the data in a comma-delimited ASCII format (txt).

**TABLE 1720-2**  
**Asset Attribute Data Form Examples**

General Information Worksheet

	A	B	C
1	<b>Date of submittal</b>	3/3/2009	
2			
3	<b>Collection Date</b>	3/3/2009	
4			
5	<b>Project Number</b>	123456	
6			
7	<b>Project Name</b>	ABC	
8			
9	<b>Contractor Name</b>	Joe Contractor	
10			
11	<b>Company</b>	Your Company	
12			

General Info / Hydrants / Valve / Manhole / Meter / Fitting / Cleanout / Pipes / Structures / Easements

Hydrants Worksheet

	A	B	C	D	E	F	H	I
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>Service Type</b>		
2	1	H001	535896.7840	1491359.5830	99.78	Water		
3	2	H002	536062.0800	1491360.9250	99.20	Water		
4	3	H002	509643.9000	1481344.6000	99.20	Water		

General Info / **Hydrants** / Valve / Manhole / Meter / Fitting / Cleanout / Pipes / Structures / Easements

Valves Worksheet

	B	C	D	E	F	G
1	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>Valve Type</b>	<b>Service Type</b>
2	V001	535887.9950	1491394.7730	96.74	Gate	Water
3	V002	535884.7480	1491396.1010	91.27	Gate	Water
4	V003	535883.6870	1491393.4900	92.18	Gate	Water

General Info / Hydrants / **Valve** / Manhole / Meter / Fitting / Cleanout / Pipes / Structures / Easements

### Manhole Worksheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>Invert Elev N</b>	<b>Invert Elev NE</b>	<b>Invert Elev E</b>	<b>Invert Elev SE</b>	<b>Invert Elev S</b>	<b>Invert Elev SW</b>	<b>Invert Elev W</b>	<b>Invert Elev NW</b>	<b>Service Type</b>
2	15	15	535898.3040	1491144.0450	96.31	91.56	88.81			88.71		88.61		Water Reclamation
3	277	277	505962.0207	1474906.7832	92.76		86.83				86.85			Water Reclamation
4	278	278	506130.5461	1475093.6556	91.00				85.95				87.2	Water Reclamation
5	279	279	505993.3960	1475243.3448	92.36				88.6					Water Reclamation

General Info / Hydrants / Valve / **Manhole** / Meter / Fitting / Cleanout / Pipes / Structures / Easements / Lookup / Relation

### Meter Worksheet

	A	B	C	D	E	F	G
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>Meter Type</b>	<b>Service Type</b>
2	7	7	535887.9950	1491394.7730	96.74	Flow	Water

General Info / Hydrants / Valve / Manhole / **Meter** / Fitting / Cleanout / Pipes / Structures / Easements

### Fitting Worksheet

	A	B	C	D	E	F	G
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>Fitting Type</b>	<b>Service Type</b>
2	20008	F0001	538549.20	1475457.69	78.94	Tee	Water Reclamation
3	20010	F0002	538544.73	1475457.74	78.94	Tee	Water Reclamation
4	20013	F0003	538544.36	1475467.92	79.02	Tee	Water Reclamation

General Info / Hydrants / Valve / Manhole / Meter / **Fitting** / Cleanout / Pipes / Structures / Easements

### Cleanout Worksheet

	A	B	C	D	E	F	H
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>Service Type</b>	
2	15	15	535898.3040	1491144.0450	96.31	Water Reclamation	
3	277	277	505962.0207	1474906.7832	92.76	Water Reclamation	

General Info / Hydrants / Valve / Manhole / Meter / Fitting / **Cleanout** / Pipes / Structures / Easements

### Pipes Worksheet

	A	B	C	D	E	F	G	H	I
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>W Pipe Type</b>	<b>WW Pipe Type</b>	<b>RW Pipe Type</b>	<b>Service Type</b>
2	20001	P00001	1475448.92	538024.96	81.5	Distribution	Pressurized		Water Reclamation
3	20002	P00002	1475487.58	538055.74	79.74	Distribution	Pressurized		Water Reclamation
4	20004	P00003	1475470.75	538166.01	79.46	Distribution	Pressurized		Water Reclamation

General Info / Hydrants / Valve / Manhole / Meter / Fitting / Cleanout / **Pipes** / Structures / Easements

### Structures Worksheet

	A	B	C	D	E	F	G
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>	<b>Structure Type</b>	<b>Service Type</b>
2	20	3980	535886.9150	1491144.3200	96.17	PumpStation	Water Reclamation

General Info / Hydrants / Valve / Manhole / Meter / Fitting / Cleanout / Pipes / **Structures** / Easements

### Easements Worksheet

	A	B	C	D	E	F	G
1	<b>ID Number</b>	<b>Utilities Asset Number</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>		
2	1721	1721	468066.6800	1515018.8300			
3	1722	1722	468066.9400	1514983.8300			
4	1723	1723	468041.9400	1514983.6500			
5	1724	1724	468041.9400	1515018.6400			

Hydrants / Valve / Manhole / Meter / Fitting / Cleanout / Pipes / Structures / Easements

Note: Do not fill out Utilities Asset Number (grey) column.

**TABLE 01720-3  
PIPE DEFLECTION TABLE EXAMPLE**

<b>Project:</b> <b>Contractor:</b> <b>Progress Mtg Date:</b> <b>Contract #:</b> <b>Dwg Sheet #:</b> <b>Utility Type:</b> <b>Pipe Manufacturer:</b> <b>Pipe size &amp; material:</b> <b>PVC Manufacturer Deflection:</b> <b>County Allowable Deflection:</b> 75% <b>Allowable Angle of Offset:</b> <b>Allowable Radius of Curvature:</b> <b>Laying Length of Pipe:</b>					FM National Pipe 16" PVC C905 6 inches 4.5 inches 1.5 degrees 764 feet 20 feet							
ID	Size and Type	Northing	Easting	Elev.	Calculations Including Elevation (XYZ)							
					Distance between points AB	Distance between points BC	Distance between points AC	Total Deflection Ø'	Radius of Curve''	Average Offset Angle'''	Average Offset''''	
					Length AB ft	Length BC ft	Length AC ft	XYZ (w elevation) degrees	XYZ (w elevation) ft	per laying length degrees	per laying length inches	
14041	16" FM	1505131.50	468948.53	107.68	-	-	-	-	-	-	-	-
7000	16" FM	1505059.60	468932.08	108.15	73.76	38.93	112.66	5.48	1,178.35	0.97	4.07	
2128	16" FM	1505022.11	468921.60	108.55	38.93	39.61	78.54	2.29	1,961.65	0.58	2.45	
2127	16" FM	1504983.85	468911.35	108.29	39.61	38.35	77.96	1.78	2,505.50	0.46	1.92	
2126	16" FM	1504946.67	468901.96	107.81	38.35	39.13	77.42	8.79	505.16	2.27	9.51	
2125	16" FM	1504908.11	468895.31	107.48								

Data that has been inputted

Values in yellow are over spec



\*Uses law of cosines to determine angle ABC and  $\emptyset$ .  
angle ABC =  $\arccos((AB^2+BC^2-AC^2)/(2*AB*BC))$   
 $180-\emptyset/2 = \text{angle ABC}$   
Calculate the total deflection  $\emptyset$ .  
to the outer point (A or C) is equal in angle to  
the approach from the next point along the

\*\* Uses law of sines, using the chord length AC and radius R.  
Since  $\sin((\emptyset/2)*(PI/180))=(\text{Chord}/2)/R$  and length AC=Chord  
 $R=AC/(2*\sin(\emptyset*PI/360))$   
This calculation assumes an average radius over the bend between three points.

\*\*\* Adds the lengths of AB + BC / 20ft to get an approximate number of bends over the span.  
This value is divided by the total deflection  
angle to calculate the average bend angle of  
This assumes that the bend angle consistent across the entire length.

\*\*\*\* Uses average offset angle and laying length of pipe.

## PART 3 - EXECUTION

### 3.01 SURVEY FIELD WORK

- A. Locate, reference, and preserve existing horizontal and vertical control points and property corners shown on the Drawings prior to starting any construction Work. If the Surveyor performing the Work discovers any discrepancies that will affect the Project, the Contractor must immediately report these findings to the County. All survey work shall meet the requirements as defined in Florida Administrative Code 61G17-6. Reference and preserve all survey points during construction. If survey points are disturbed, it is the responsibility of the Contractor's Surveyor to reset the points at the Contractor's expense. Copies of the Surveyor's field notes and/or electronic files for point replacement shall be provided to the County.
1. The Surveyor shall locate all improvements for the project As-Built Asset Attribute Data using State Plane Coordinates as the horizontal datum and the benchmark referenced on the Drawings as the vertical datum. The County's Engineer will provide electronic files of the Drawings to be used by the Surveyor in complying with these specifications.
  2. The construction layout shall be established from the reference points shown or listed on the Drawings. The accuracy of any method of staking shall be the responsibility of the Contractor. All construction layout staking shall be done such as to provide for easy verification of the Work by the County.
- B. Use survey control points to layout such work tasks as the following:

1. Clearing, grubbing, work limits, right-of-way lines and easements
  2. Locations for pipelines and all associated structures and appurtenances
- C. The Surveyor shall reference and replace any project control points, boundary corners, benchmarks, section corners, and right-of-way monuments that may be lost or destroyed, at no additional cost to the County. Establish replacement points based on the original survey control. Copies of all reference field notes and/or electronic files for point replacement shall be submitted to the County.

### 3.02 CONSTRUCTION PROGRESS MEETINGS

- A. Contractor shall provide progressive and a final version of the Record Documents both as paper copies and electronic format described below.
1. Construction Contract, As-Built Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.
  2. Specifications and Addenda: Record manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed as well as any changes made by Field Order, Change Order or other.
  3. Change orders, verbal orders, and other modifications to Contract.
  4. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).
  5. 5. Accepted Shop Drawings, samples, product data, substitution and “or-equal” requests.
  6. 6. Field test records, inspection certificates, manufacturer certificates and construction photographs.
- B. Progressive record documents shall include the following updated monthly tables certified by the Surveyor:
1. As-Built Asset Attribute Data Table: Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements. The monthly submittal shall include the Surveyor’s statement regarding the constructed improvements being within the specified accuracies as described in Table 01720-1 Minimum Survey Accuracies or if not, indicating the variances.
  2. Gravity Main Table: Surveyor shall prepare and update a Gravity Main Table to include as a minimum the pipe segment identification, pipe lengths, manhole inverts and tops, and slopes for gravity mains. Surveyor shall certify the data entered are correct and indicate if the minimum slopes have not been met.
  3. Pipe Deflection Table: Surveyor shall input the type of pipe, pipe manufacturer, PVC manufacturer deflection allowance, allowable angle of

offset and radius of curvature, laying length of pipe, and coordinates. Surveyor shall certify the data entered are correct and indicate if the deflection allowance, offset or radius of curvature exceeds the manufacturer's recommendations. *County will provide an electronic version of a blank table that shall be used to input the data.*

3.03 FINAL RECORD DOCUMENTS SUBMITTAL

- A. Submit the Final Record Documents within 20 days after Substantial Completion.
  - 1. Participate in review meetings as required and make required changes and promptly deliver the Final Record Documents to the Engineer and County.

3.04 STORAGE AND PRESERVATION

- A. Store Record Documents and samples at a protected location in the project field office apart from documents used for construction.
  - 1. Provide files and racks for storage of documents
  - 2. Provide locked cabinet or secure space for storage of samples.
- B. File documents and samples in accordance with CSI format with section numbers matching those in the Contract Documents.
- C. In the event of loss of recorded data, use means necessary to again secure the data to the County's approval.
  - 1. Such means shall include, if necessary in the opinion of the County, removal and replacement of concealing materials.
  - 2. In such cases, provide replacements of the concealing materials to the standards originally required by the Contract Documents.

**END OF SECTION**

**SECTION 01730  
OPERATING AND MAINTENANCE DATA**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. The Contractor shall compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.
2. The Contractor shall prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.
3. The Contractor shall instruct Owner's personnel in maintenance of products and in operation of equipment and systems.

1.02 QUALITY ASSURANCE

A. Preparation of data shall be done by personnel:

1. Trained and experienced in maintenance and operation of described products.
2. Familiar with requirements of this Section.
3. Skilled as a technical writer to the extent required to communicate essential data.
4. Skilled as draftsman competent to prepare required drawings.

1.03 FORM OF SUBMITTALS

A. Prepare data in form of an instructional manual for use by Owner's personnel.

B. Format:

1. Size: 8 1/2-inches x 11 inches.
2. Paper: 20 pound minimum, white, for typed pages.
3. Text: Manufacturer's printed data, or neatly typewritten.
4. Drawings:
  - a. Provide reinforced punched binder tab, bind in with text.
  - b. Reduce larger drawings and fold to size of text pages but not larger than 11 inches x 17 inches.
5. Provide fly-leaf for each separate products, or each piece of operating equipment.

- a. Provide typed description of products and major component parts of equipment.
  - b. Provide indexed tabs.
6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
- a. Title of Project.
  - b. Identity of separate structure as applicable.
  - c. Identity of general subject matter covered in the manual.

C. Binders:

1. Commercial quality three D-ring binders with durable and cleanable plastic covers.
2. Maximum post width: 2 inches.
3. When multiple binders are used, correlate the data into related consistent groupings.

D. Electronic Format:

1. In addition to hardcopies for the Owners personnel one (1) electronic copy (PDF) of all Operation and Maintenance Manuals shall be provided to the Owner and Engineer.

#### 1.04 CONTENT OF MANUAL

A. Neatly typewritten table of contents for each volume, arranged in systematic order.

1. Contractor, name of responsible principal, address and telephone number.
2. A list of each product required to be included, indexed to content of the volume.
3. List, with each product, name, address and telephone number of:
  - a. Subcontractor or installer, manufacturer and supplier name, address and telephone number.
  - b. A list of each product required to be included, indexed to content of the volume.
  - c. Identify area of responsibility of each.
  - d. Local source of supply for parts and replacement name, address and telephone number.
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

B. Product Data:

1. Include only those sheets which are pertinent to the specific product.
  2. Annotate each sheet to:
    - a. Clearly identify specific product or part installed.
    - b. Clearly identify data applicable to installation.
    - c. Delete references to inapplicable information.
  3. Operation and maintenance information as herein specified.
  4. Record shop drawings as submitted and approved with all corrections made for each product.
- C. Drawings:
1. Supplement product data with drawings as necessary to clearly illustrate:
    - a. Relations of component parts of equipment and systems.
    - b. Control and flow diagrams.
  2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
  3. Do not use Project Record Documents as maintenance drawings.
- D. Written text, as required to supplement product data for the particular installation:
1. Organize in consistent format under separate headings for different procedures.
  2. Provide logical sequence of instructions of each procedure.
- E. Copy of each warranty, bond and service contract issued.
1. Provide information sheet for Owner's personnel, give:
    - a. Proper procedures in event of failure.
    - b. Instances which might affect validity of warranties or bonds.

#### 1.05 MANUAL FOR MATERIALS AND FINISHES

- A. Submit six (6) copies of complete manual in final form in addition to one (1) electronic copy (PDF).
- B. Content: for applied materials and finishes:
  1. Manufacturer's data, giving full information on products.
    - a. Catalog number, size, and composition.
    - b. Color and texture designations.
    - c. Information required for reordering special manufactured products.
  2. Instructions for care and maintenance.

- a. Manufacturer's recommendation for types of cleaning agents and methods.
  - b. Cautions against cleaning agents and methods which are detrimental to product.
  - c. Recommend schedule for cleaning and maintenance.
- C. Content, for moisture protection and weather-exposed products:
- 1. Manufacturer's data, giving full information on products.
    - a. Applicable standards.
    - b. Chemical composition.
    - c. Details of installation.
  - 2. Instructions for inspection, maintenance and repair.
- D. Additional requirements for maintenance data: Respective sections of Specifications.

#### 1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit six (6) copies of complete manual in final form in addition to one (1) electronic copy (PDF).
- B. Content, for each unit of equipment and system, as appropriate:
- 1. Description of unit and component parts.
    - a. Function, normal operating characteristics, and limiting conditions.
    - b. Performance curves, engineering data and tests.
    - c. Complete nomenclature and commercial number of replaceable parts.
    - d. Summary of information listed on equipment and motor data plates.
  - 2. Operating procedures:
    - a. Start-up, break-in, routine and normal operating instructions.
    - b. Regulation, control, stopping, shut-down and emergency instructions.
    - c. Summer and winter operating instructions.
    - d. Special operating instructions.
  - 3. Maintenance procedures:
    - a. Routine operations.
    - b. Guide to "trouble-shooting".
    - c. Disassembly, repair and reassembly.
    - d. Alignment, adjusting and checking.
  - 4. Servicing and lubrication required.
  - 5. Manufacturer's printed operating and maintenance instructions.
  - 6. Description of sequence of operation by control manufacturer.

7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
    - a. Predicted life of parts subject to wear.
    - b. Items recommended to be stocked as spare parts.
  8. As-installed control diagrams by controls manufacturer.
  9. Each Contractor's coordination drawings.
  10. Charts of valve tag numbers, with location and function of each valve.
  11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
  12. Other data as required under pertinent sections of specifications.
  13. Approved record shop drawings with all corrections made, and a copy of the warranty statement, check-out memo, and demonstration test procedures and certification.
- C. Content, for each electric and electronic system, as appropriate:
1. Description of system and component parts.
    - a. Function, normal operating characteristics, and limiting conditions.
    - b. Performance curves, engineering data and tests.
    - c. Complete nomenclature and commercial number of replaceable parts.
  2. Circuit directories of panelboards.
    - a. Electrical service
    - b. Controls
  3. As installed color coded wiring diagrams.
  4. Operating procedures:
    - a. Routine and normal operating instructions.
    - b. Sequences required.
    - c. Special operating instructions.
  5. Maintenance procedures:
    - a. Routine operations.
    - b. Guide to "trouble-shooting.
    - c. Disassembly, repair and reassembly.
    - d. Adjustment and checking.
  6. Manufacturer's printed operating and maintenance instructions.
  7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.



8. Other data as required under pertinent sections of specifications.
- D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
- E. Additional requirements for operating and maintenance data: Respective sections of Specifications.

#### 1.07 SUBMITTAL SCHEDULE

- A. Submit two (2) copies of preliminary draft of proposed formats and outlines of contents of Operation and Maintenance Manuals within 90 days after Notice to Proceed. Sets of example O&M manuals are available for examination upon request.
- B. Submit two (2) copies of completed data in preliminary form no later than 20 days following Engineer's review of the last shop drawing of a product and/or other submittal specified under Section 01340, but no later than delivery of equipment. One copy will be returned with comments to be incorporated into the final copies and the other copy will be retained on-site for use in any early training.
- C. Submit six (6) copies of approved manual in final form directly to the offices of the Engineer within 10 days after the reviewed copy or last item of the reviewed copy is returned.
- D. Provide six (6) copies of addenda to the operation and maintenance manuals as applicable and certificates as specified within 30 days after final inspection.

#### 1.08 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to demonstration test, fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems.
- B. Operating and maintenance manual shall constitute the basis of instruction. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.
- C. Instructors shall be fully qualified personnel as outlined within the individual equipment specifications. If no specific training specifications are listed with the equipment, the Contractor shall provide the instruction with qualified Contractor personnel.
- D. The instructors shall provide for and prepare lesson scopes and handouts for up to five individuals designated by the Owner that outline the items to be covered. Separate sessions for operation and maintenance instruction shall be provided consecutively. Handouts shall be submitted to the Owner with at least one week's notice prior to the training sessions.

- E. All instruction sessions shall be video taped with portable video cameras and tapes supplied by the Contractor. Video taping shall be made by the Contractor under the direction of the Owner with DVD compatible taping equipment.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 01740  
WARRANTIES AND BONDS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. Compile specified warranties and bonds, as in the General Conditions and as specified in these Specifications.
2. Submit to Engineer for review and transmittal to Owner.

B. Related Work Described Elsewhere: Contract Closeout 01700

1.02 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Number of original signed copies required: Two (2) each.

C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.

1. Product or work item.
2. Firm, with name of principal, address and telephone number.
3. Scope.
4. Date of beginning of warranty, bond or service and maintenance contract.
5. Duration of warranty, bond or service maintenance contract.
6. Provide information for Owner's personnel: Instances which might affect the validity or warranty or bond.
7. Contractor, name of responsible principal, address and telephone number.

1.03 FORM OF SUBMITTALS

A. Prepare in duplicate packets.

B. Format:

1. Size 8 1/2-inches x 11 inches, punch sheets for standard three-post binder. Fold larger sheets to fit into binders. The Contractor shall submit warranties in a separate/stand-alone binder.

2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS". List:
  - a. Title of Project.
  - b. Name of Contractor.
- C. Binders: Commercial quality, three (3) D-ring binder, with durable and cleanable plastic covers and maximum ring size of two inches.

#### 1.04 WARRANTY SUBMITTALS REQUIREMENTS

- A. For all material, submit a warranty from the product manufacturer. The manufacturer's warranty period shall be concurrent with Contractor's for one (1) year, unless otherwise specified, commencing at the time of final acceptance by Owner.
- B. The Contractor shall be responsible for obtaining certificates for material warranty for all major items which list for more than \$1,000. The Engineer reserves the right to request warranties for material not classified as major. The Contractor shall still warrant material not considered to be "major" in the Contractor's one-year warranty period even though certificates of warranty may not be required.
- C. In the event that the material manufacturer or supplier is unwilling to provide a one (1) year warranty commencing at the time of Owner acceptance, the Contractor shall obtain from the manufacturer a two (2) year warranty commencing at the time of equipment delivery to the job site. This two-year warranty from the manufacturer shall not relieve Contractor of the one-year warranty starting at the time of Owner acceptance of the equipment.
- D. Owner shall incur no labor or equipment cost during the guarantee period.
- E. Guarantee shall cover all necessary labor, and materials resulting from faulty or inadequate design, improper assembly or erection, defective workmanship and materials, leakage, breakage or other failure of all equipment and components furnished by the Manufacturer.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01800  
MISCELLANEOUS WORK AND CLEANUP**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. This Section includes operations which cannot be specified in detail as separate items but can be sufficiently described as to the kind and extent to work involved. The Contractor shall furnish all labor, materials, equipment and incidentals to complete the work under this Section.
2. The work of this Section includes, but is not limited to, the following:
  - a. Restoring of driveways and fences.
  - b. Cleaning up.
  - c. Incidental work.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Materials required for this Section shall be of the same quality as materials that are to be restored. Where possible, the Contractor shall reuse existing materials that are removed and then replaced.

**PART 3 - EXECUTION**

3.01 RESTORING OF DRIVEWAYS, SIDEWALKS AND FENCES

- A. Existing driveways and sidewalks disturbed by the Contractor shall be replaced. Paved drives and sidewalks shall be repaved to the limits and thickness existing prior to construction. Gravel drives shall be replaced and regraded.
- B. The Contractor shall remove, store and replace existing fences during construction. Only the sections directed by the Engineer shall be removed. If any section of fence is damaged due to the Contractor's negligence, it shall be replaced with fencing equal to or better than that damaged, and the work shall be satisfactory to the Engineer.

3.02 CLEAN UP

- A. The Contractor shall remove all construction material, buildings, equipment and other debris remaining on the job as the result of construction operations and shall render the site of the work in a neat and orderly condition. All suitable excess excavated material shall remain on site.

3.03 INCIDENTAL WORK

- A. Do all incidental work not otherwise specified, but obviously necessary for the proper completion of the contract as specified and as shown on the Drawings.

**END OF SECTION**

**SECTION 02230  
SITE PREPARATION**

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Site clearing, tree protection, stripping topsoil and demolition.

B. Related Specification Sections include but are not necessarily limited to:

1. Orange County Utilities- Bidding Requirements, Contract Forms, and Conditions of the Contract Documents.
2. Division 01 - General Requirements.
3. Section 02310 - Finish Grading.
4. Section 02370 - Erosion and Sediment Control.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION**

3.01 PREPARATION

A. Protect existing trees and other vegetation to remain against damage.

1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
3. Provide temporary protection as required.

B. Repair or replace trees and vegetation damaged by construction operations.

1. Repair to be performed by a qualified tree surgeon.
2. Remove trees which cannot be repaired and restored to full-growth status.
3. Replace with new trees of minimum 4 IN caliper.



- C. Owner will obtain authority for removal and alteration work, if any, on adjoining property.

### 3.02 SITE CLEARING

#### A. Topsoil Removal:

1. Strip topsoil to depths encountered.
  - a. Remove heavy growths of grass before stripping.
  - b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
  - c. Separate from underlying subsoil or objectionable material.
2. Stockpile topsoil where directed by Engineer.
  - a. Construct storage piles to freely drain surface water.
  - b. Seed or cover storage piles to prevent erosion.
3. Do not strip topsoil in wooded areas where no change in grade occurs.
4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.

#### B. Clearing and Grubbing:

1. Clear from within limits of construction all trees not marked to remain.
  - a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
  - a. Totally grub under areas to be paved.
  - b. Grubbing in lawn areas:
    - i. In cut areas, totally grub.
    - ii. In fill areas, where fill is less than 3 FT totally grub ground.
    - iii. Where fill is 3 FT or more in depth, or where there are no plant operations buildings, structures, concrete support slabs, or at-grade plant process areas and equipment, stumps may be left no higher than 6 IN above existing ground surface, unless assessed and specified otherwise by the Engineer.

#### C. Disposal of Waste Materials:

1. Do not burn combustible materials on site.
2. Remove all waste materials from site.

3. Do not bury organic matter on site.

3.03 ACCEPTANCE

A. Upon completion of the site clearing, obtain Engineer's acceptance of the extent of clearing, depth of stripping and rough grade.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 02240  
DEWATERING**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: The work to be performed under this section shall include the design and installation of a temporary dewatering system until completion of construction to remove subsurface waters from structure or utility trench excavations as required.

1.02 QUALITY ASSURANCE

- A. Qualifications: The temporary dewatering system shall be designed by a firm who regularly engages in the design of dewatering systems and who is fully experienced, reputable and qualified in the design of such dewatering systems.
- B. Standards: The dewatering of any excavation areas and the disposal of water during construction shall be in strict accordance with all local and state government rules and regulations. If a consumptive use permit is required by SJRWMD or FDEP, the Contractor shall be responsible for obtaining said permit.

1.03 SUBMITTALS

- A. Submit to the Engineer for review, the proposed methods of construction, including dewatering, excavation, bedding, filling, compaction and backfilling for the various portions of the Work. Review shall be for method only. The Contractor shall remain responsible to the adequacy and safety of the methods.
- B. Submittals shall be in accordance with Section 01340, and shall include the following:
  - 1. Design Notes and Drawings.
  - 2. Descriptive literature of the temporary dewatering system.
  - 3. Layout of all piping involved.
  - 4. Observation well locations.

1.04 CRITERIA

- A. The dewatering system shall be developed to the point that is capable of dewatering the site surrounding all structures or utility trenches as shown on the Drawings. Each wellpoint system shall be capable of dewatering and maintaining groundwater levels at the respective excavations. Observation wells shall be constructed for the purpose of testing each system.

1.05 PUMPING AND DRAINAGE

- A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation

condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. The Contractor shall submit to the Engineer, for review, a plan for dewatering systems prior to commencing work. The dewatering system installed shall be in conformity with overall construction plan.

- B. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation and to preserve the integrity of adjacent structures. As a minimum, the water level shall be two (2) feet below the trench bottom. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soil from the surrounding ground.
- C. The Contractor shall take all additional precautions or prevent uplift of any structure during construction.
- D. The conveying of water in open ditches or trenches will not be allowed. Permission to use any storm sewers, or drains, for water disposal purposes shall be obtained from the Owner. Any requirements and costs for such use shall be the responsibility of the Contractor. However, the Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and the Contractor shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by the Engineer or the plant owner at no cost to the Owner.
- E. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.
- F. Removal of dewatering equipment shall be accomplished after the Contractor and the Engineer agree that the system is no longer required; the material and equipment constituting the system, shall be removed by the Contractor.
- G. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater or receiving water quality.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. The equipment specified herein shall be standard dewatering equipment of proven ability as designed, manufactured, and installed by firms having experience in the design and production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods.
- B. The Contractor shall submit a conceptual plan for the dewatering system prior to commencing work. The dewatering system installed shall be in conformity with the overall construction plan. Dewatering system shall be designed in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the proposed structures or utilities and to preserve the integrity of any adjacent structures.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Dewatering: The Contractor shall install a temporary dewatering system for the removal of subsurface water encountered during construction of the proposed structures or utilities.
- B. CUP Permits: If pumping requirements exceed certain limits, the Contractor shall pay for and obtain a CUP from the water management district (SFWMD) for such pumped volumes.

### **3.02 PROTECTION AND SITE CLEAN-UP**

- A. At all times during the progress of the work the Contractor shall use all reasonable precautions to prevent either tampering with the wellpoints (if used).
- B. Immediately upon completion of the dewatering operations, the Contractor shall remove all of his equipment, materials, and supplies from the site of the work, remove all surplus materials and debris, fill in all holes or excavations, and grade the site to elevations of the surface levels which existed before the work started. The site shall be thoroughly cleaned and graded as directed by the Engineer.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 02310  
FINISH GRADING**

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Topsoiling and finished grading.

B. Related Specification Sections include but are not necessarily limited to:

1. Orange County Utilities - Bidding Requirements, Contract Forms, and Conditions of the Contract Documents.
2. Division 01 - General Requirements.
3. Section 02230 - Site Preparation.
4. Section 02370 - Erosion and Sediment Control.

C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.02 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
2. Project Data: Test reports for furnished topsoil.

1.03 SITE CONDITIONS

A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Topsoil:



1. Original surface soil typical of the area.
2. Existing topsoil stockpiled under Specification Section 02230.
3. Capable of supporting native plant growth.

2.02 TOLERANCES

- A. Finish Grading Tolerance: 0.1 FT plus/minus from required elevations.

**PART 3 - EXECUTION**

3.01 PREPARATION

- A. Correct, adjust and/or repair rough graded areas.
  1. Cut off mounds and ridges.
  2. Fill gullies and depressions.
  3. Perform other necessary repairs.
  4. Bring all sub-grades to specified contours, even and properly compacted.
- B. Loosen surface to depth of 2 IN, minimum.
- C. Remove all stones and debris over 2 IN in any dimension.

3.02 ROUGH GRADE REVIEW

- A. Reviewed by Engineer in Specification Section 02230.

3.03 PLACING TOPSOIL

- A. Do not place when subgrade is wet or frozen enough to cause clodding.
- B. Spread to compacted depth of 4 IN for all disturbed earth areas.
- C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to Owner.
- D. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.
- E. Provide finished surface smooth and true to required grades.
- F. Restore stockpile area to condition of rest of finished work.

3.04 ACCEPTANCE

- A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.
- B. Make test holes where directed to verify proper placement and thickness of topsoil.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 02315  
EXCAVATION AND FILL**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: This section includes materials, testing, and earthwork for excavations and fills.

1.02 SUBMITTALS

- A. Submit excavation and shoring drawings for worker protection in accordance with the General Conditions.
- B. Submit six (6) copies of a report from a testing laboratory verifying that the material conforms to the gradation specified.

1.03 TESTING FOR COMPACTION

- A. Determine the density of soil in place in accordance with the sand cone method, ASTM D1556, or rubber balloon method, ASTM D 2167.
- B. Determine the laboratory moisture-density relations and maximum density by ASTM D 1557 or D 2049.
- C. Sample fill materials by ASTM D 75.
- D. Compaction shall be deemed to comply with the specifications when no more than one test of any three consecutive tests falls below the specified relative compaction. The one test shall be no more than three percentage points below the specified compaction. The Contractor shall pay the costs of any retesting of work not conforming to the specifications.
- E. "Relative compaction" is the ratio, expressed as a percentage, of the in-place density to the laboratory maximum density.
- F. Density tests will be made for determination of specified compaction by an independent testing laboratory provided by the Contractor as approved by the Owner/Engineer. Tests will be made in locations reviewed by the Engineer, but spaced not more than 50 feet apart and a minimum of three tests per compaction area in each vertical lift.
- G. If any tests are unsatisfactory, re-excavate and re-compact the fill or backfill until the desired compaction is obtained. Additional compaction tests will be taken to each side of an unsatisfactory test at locations reviewed by the Engineer to determine the extent of re-excavation and re-compaction necessary.
- H. Contractor will pay for each failed compaction test and for each additional test taken to determine extent of re-excavation and re-compaction as described previously.

## **PART 2 - PRODUCTS**

### **2.01 FILL AND BACKFILL**

- A. Unless otherwise specified, fill and backfill shall be clean, granular sand that is free from organic matter, roots, debris, and rocks larger than three inches in the greatest dimension and having less than 10 percent passing the No. 200 U.S. sieve size.
- B. Water for Compaction: Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l. Provide all water needed for earthwork. Provide temporary piping and valves to convey water from the source to the point of use.

## **PART 3 - EXECUTION**

### **3.01 COMPACTION REQUIREMENTS**

- A. Unless otherwise shown on the Drawings, compact fill, embankments, and backfills to 98 percent maximum density per AASHTO T-180.
- B. Dewatering: Provide and operate equipment adequately to keep excavations and trenches free of water. Remove water during period when concrete is being deposited, when pipe is being laid, during the placing of structural fill and backfill, and for inspection/testing of the structural subgrade. Maintain the groundwater level a minimum of two feet below the bottom of excavation for all structures. Avoid settlement or damage to adjacent property. Dispose of water to an on-site drainage system. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation. Comply with discharge permit.
- C. Excavation is unclassified. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction.
- D. Placing and Compacting Fill Materials:
  - 1. Excavated material which conforms to the specifications may be used for fill or backfill.
  - 2. Place all materials at optimum moisture content.
  - 3. Place fill in maximum 8-inch lifts and compact each lift to the extent specified.
- E. Moisture Control of Earth Material: During the compaction operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the material. Maintain moisture content uniform throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the material. At the time of compaction, the water content of the material shall be at optimum water content or within two percentage points above optimum. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.
- F. Site Grading:

1. Perform earthwork to the lines and grades shown on the Drawings. Shape, trim and finish slopes to conform with the lines, grades and cross-sections as shown. Make slopes free of exposed roots and loose rocks exceeding three inches in diameter. Round tops of banks to circular curves as shown on the plans.
  2. Neatly and smoothly trim rounded surfaces. Do not over-excavate and backfill to achieve the proper grade.
- G. Disposal of Excess Excavation: Dispose of excess excavated suitable materials at designated on-site stockpile areas indicated on the drawings or directed by the Owner or Engineer. Contractor shall make his own arrangements for the disposal of all excess unsuitable material and bear all costs incidental to such disposal.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 02320  
TRENCHING, BEDDING AND BACKFILLING**

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Excavation, trenching, bedding and backfilling for underground utilities.

B. Related Specification Sections include but are not necessarily limited to:

1. Orange County- Bidding Requirements, Contract Forms, and Conditions of the Contract Documents.
2. Division 01 - General Requirements.
3. Division 16 - Electrical.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM International (ASTM):

- a. C33, Standard Specification for Concrete Aggregates.
- b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- d. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
- e. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

- B. Qualifications: Hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section.

1.03 DEFINITIONS

- A. Excavation: All excavation will be defined as unclassified.

1.04 SUBMITTALS

- A. Shop Drawings:



1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
  2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
  4. Submit sieve analysis reports on all granular materials.
- B. Miscellaneous Submittals:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.

#### 1.05 PROJECT SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
  1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to property owners.
- B. Provide full access to public and private premises and fire hydrants, at roadways, parking areas, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
- C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.
- D. Verify location of existing underground utilities.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIALS

- A. Backfill Material:
  1. As approved by Engineer.
    - a. Free of rock cobbles, roots, sod or other organic matter material.
    - b. Moisture content at time of placement: 3 percent plus/minus of optimum moisture content as specified in accordance with ASTM D698.

- B. Subgrade Stabilization Materials: Provide subgrade stabilization material consisting of high bearing value soil, sand-clay, ground limestone, crushed limerock, coquina, or any other material suitable for stabilization. Muck shall not be used.
- C. Bedding Materials:
  - 1. As approved by the Engineer.
  - 2. Granular bedding materials:
    - a. ASTM D2321 Class 1B.
      - i. Well-graded crushed stone.
    - b. ASTM C33, gradation 67 (3/4 IN to No. 4 sieve) or FDOT No. 57 Stone as directed by Engineer.
  - 3. Flowable fill:
    - a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.
    - b. Material characteristics:
      - i. The approximate quantities of each component per cubic yard of mixed material shall be as follows:
        - I.Cement (Type I or II): 50 LBS.*
        - II.Fly ash: 200 LBS.*
        - III.Fine sand: 2,700 LBS.*
        - IV.Water: 420 LBS.*
        - V.Air content: 10 percent.*
      - ii. Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.
      - iii. Approximate compressive strength should be 85 to 175 psi.
      - iv. Fine sand shall be an evenly graded material having not less than 95 percent passing the No. 4 sieve and not more than 5 percent passing the No. 200 sieve.

**PART 3 - EXECUTION**

3.01 GENERAL

- A. Remove and dispose of materials determined to be unsuitable, as directed by Engineer, off site.

3.02 EXCAVATION

- A. Unclassified Excavation: Remove muck materials, clay, silt, gravel, hard pan, and loose rock or stone as directed by Engineer.

B. Excavation for Appurtenances:

1. 12 IN (minimum) clear distance between outer surface and embankment.
2. See Specification Section 02315 for applicable requirements.
3. See Specification Section 02230 for applicable requirements.

C. Groundwater Dewatering:

1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
2. Groundwater shall be drawn down and maintained at least 2 FT below the bottom of any trench or manhole excavation prior to excavation.
3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
  - a. Employ dewatering specialist for selecting and operating dewatering system.
4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction and in accordance with current permits and regulatory requirements.
6. Install groundwater monitoring wells as necessary.
7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
8. Cost of groundwater dewatering shall be included in the lineal foot unit price of the pipe installation.

D. Trench Excavation:

1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
  - a. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
    - i. Stabilize excavation to prevent undermining of existing utility and yard piping.
2. Open trench outside buildings, units, and structures:
  - a. No more than the distance between two manholes, structures, units, or 200 LF, whichever is less.

- b. Field adjust limitations as weather conditions dictate.
    - 3. Any trench or portion of trench, which is opened and remains idle for seven (7) calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
      - a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
    - 4. Observe following trenching criteria:
      - a. Trench size:
        - i. Excavate width to accommodate free working space.
        - ii. Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:
        - iii. Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
        - iv. Keep trenches free of surface water runoff.
- I. Include cost in Bid.  
II. No separate payment for surface water runoff pumping will be made.
- E. Trenching for Electrical Installations:
    - 1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
    - 2. Modify for electrical installations as follows:
      - a. Open no more than 200 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
      - b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
      - c. Do not over excavate trench.
      - d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.
      - e. See Division 16 for additional requirements.
  - F. Flowable Fill:
    - 1. Flowable fill shall be:
      - a. Discharged from a mixer by any means acceptable to the Engineer into the area to be filled.
      - b. Placed in 4 FT maximum lifts to the elevations indicated.

- i. Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
  - ii. Contractor shall place flowable fill lifts in such a manner as to prevent flotation of the pipe.
2. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
3. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DegF and rising.
4. At the time of placement, flowable fill must have a temperature of at least 40 DegF.
5. Mixing and placing shall stop when the air temperature is 38 DegF or less and falling.
6. Each filling stage shall be as continuous an operation as is practicable.
7. Contractor shall prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
8. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of Dewatering in specification 02240.

### 3.03 PREPARATION OF FOUNDATION FOR PIPE LAYING

#### A. Over-Excavation:

1. Backfill and compact to 95 percent of maximum dry density per ASTM D698.
2. Backfill with granular bedding material as option.

#### B. Unclassified Excavation (unsuitable):

1. Excavate minimum of 6 IN below bottom exterior surface of the pipe or conduit.
2. Backfill to grade with suitable earth or granular material.
3. Form bell holes in trench bottom.

#### C. Subgrade Stabilization:

1. Stabilize the subgrade when directed by the Owner.
2. Observe the following requirements when unstable trench bottom materials are encountered.
  - a. Notify Owner when unstable materials are encountered.
    - i. Define by drawing station locations and limits.

- b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
  - i. Replace with subgrade stabilization with no additional compensation.

### 3.04 BACKFILLING METHODS

- A. Do not backfill until tests to be performed on system show system is in full compliance to specified requirements.
- B. Carefully Compacted Backfill:
  - 1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
  - 2. Comply with the following:
    - a. Place backfill in lifts not exceeding 8 IN (loose thickness).
    - b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
    - c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
    - d. Compact each lift to specified requirements.
- C. Common Trench Backfill:
  - 1. Perform in accordance with the following:
    - a. Place backfill in lift thicknesses capable of being compacted to densities specified.
    - b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
    - c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.
- D. Water flushing for consolidation is not permitted.
- E. Backfilling for Electrical Installations:
  - 1. Observe the preceding Carefully Compacted Backfill paragraph or Common Trench Backfill paragraph in PART 3 of this Specification Section or when approved by the Engineer.
  - 2. Modify for electrical installation as follows:
    - a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.05 COMPACTION

A. General:

1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
2. In no case shall degree of compaction below minimum compactions specified be accepted.

B. Compaction Requirements:

1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.
  - a. Bedding material:

LOCATION	COMPACTION DENSITY
All locations	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

b. Carefully compacted backfill:

LOCATION	COMPACTION DENSITY
All applicable areas	95 percent of maximum dry density by ASTM D698

c. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	95 percent of maximum dry density by ASTM D698
Under turfed, sodded, plant seeded, nontraffic areas	Cohesive soils	85 percent of maximum dry density by ATM D698

3.06 FIELD QUALITY CONTROL

A. Testing:

1. Perform tests through recognized testing laboratory approved by Owner.

2. Perform additional tests as directed until compaction meets or exceeds requirements.
3. Cost associated with "Failing" tests shall be paid by Contractor.
4. Assure immediate access for testing of all soils related work.
5. Ensure excavations are safe for testing personnel.

**END OF SECTION**



**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 02370  
EROSION AND SEDIMENT CONTROL**

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes:

1. erosion and sediment control.

B. Related Specification Sections include but are not necessarily limited to:

1. Orange County - Bidding Requirements, Contract Forms, and Conditions of the Contract Documents.
2. Division 01 - General Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Erosion control standards: State of Florida Erosion and Sediment Control Manual – FDOT/FDEP - 2007

**PART 2 - PRODUCTS – NOT USED**

**PART 3 - EXECUTION – NOT USED**

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 02485  
SODDING**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Establishing a stand of grass by furnishing and placing grass sod. Included are fertilizing, watering, and maintenance as required to assure a healthy stand of grass. Solid sodding shall be placed in all areas where existing grass, sod, or other ground cover (regardless of its condition) is removed or disturbed by Contractor's operation unless otherwise specified or shown on the Drawings.

1.02 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the Owner for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300: Submittals.
  - 1. A certification of sod quality by the producer shall be delivered to the Owner ten days prior to use.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All material supplied shall be as specified in Section 981, FDOT Standard Specifications for Road and Bridge Construction.

2.02 GRASS SOD

- A. Grass sod for the road rights-of-way shall be Argentine Bahia (*Paspalum Notatum*) or St. Augustine to match the existing adjacent area and shall be well matted with grass roots. The sod shall be taken up in rectangles, preferably 12-inch by 24-inch, shall be a minimum of 2-inches in thickness, and shall be live, fresh, and uninjured at the time of planting.
- B. Grass sod for new construction sites and/or areas disturbed by construction on existing sites shall be Argentine Bahia (*Paspalum Notatum*) well matted with grass roots. The sod shall be taken up in rectangles, preferably 12-inch by 24-inch, shall be a minimum of 2-inches in thickness, and shall be live, fresh, and uninjured at the time of planting.
- C. It shall be reasonably free of weeds and other grasses and shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. The sod shall be planted as soon as possible after being dug and shall be shaded and kept moist until it is planted.

2.03 FERTILIZER

- A. Commercial fertilizers shall comply with the state fertilizer laws.

- B. The numerical designations for fertilizer indicate the minimum percentages (respectively) of (1) total nitrogen, (2) available phosphoric acid, and (3) water-soluble potash contained in the fertilizer.
- C. The chemical designation of the fertilizer shall be 6-6-6. At least 50% of the nitrogen shall be derived from organic sources. At least 50 % of the phosphoric acid shall be from normal super phosphate or an equivalent source, which will provide a minimum of two units of sulfur. The amount of sulfur shall be indicated on the quantitative analysis card attached to each bag or other container.

#### 2.04 WATER FOR GRASSING

- A. The water used in the sodding operations shall be by the Contractor as approved by the Owner.

### **PART 3 - EXECUTION**

#### 3.01 PREPARATION OF GROUND

- A. The area over which the sod is to be placed shall be scarified or loosened to a depth and then raked smooth and free from debris. Where the soil is sufficiently loose and clean, the Owner, at its discretion, may authorize the elimination of ground preparation.

#### 3.02 APPLICATION OF FERTILIZER

- A. Before applying fertilizer, the soil pH shall be brought to a range of 6.0 - 7.0.
- B. The fertilizer shall be spread uniformly over the area to be sodded at the rate of 700-pounds per acre, or 16-pounds per 1,000 square feet, by a spreading device capable of uniformly distributing the material at the specified rate. Immediately after spreading, the fertilizer shall be mixed with the soil to a depth of approximately 4-inches.
- C. On steep slopes, where the use of a machine for spreading or mixing is not practicable, the fertilizer shall be spread by hand and raked in and thoroughly mixed with the soil to a depth of approximately 2-inches.

#### 3.03 PLACING SOD

- A. The sod shall be placed on the prepared surface, with edges in close contact and shall be firmly and smoothly embedded by light tamping with appropriate tools.
- B. Sod which has been cut for more than 72-hours shall not be used unless specifically authorized by the Owner after the inspection thereof. Sod which is not planted within 24-hours after cutting shall be stacked in an approved manner, maintained, and properly moistened. Any pieces of sod that, after placing, show an appearance of extreme dryness shall be removed and replaced by fresh, uninjured pieces.
- C. Sodding shall not be performed when weather and soil conditions are, in the Owner's opinion, unsuitable for proper results.

3.04 WATERING

- A. The areas on which the sod is to be placed shall contain sufficient moisture, as determined by the Owner, for optimum results. After being placed, the sod shall be kept in a moist condition to the full depth of the rooting zone for at least 2-weeks. Thereafter, the Contractor shall apply water as needed until the sod roots and starts to grow for a minimum of 60-days (or until Final Completion, whichever is latest).

3.05 MAINTENANCE

- A. The Contractor shall maintain, at his expense, the sodded areas in a satisfactory condition until Final Completion of the Project. Such maintenance shall include repairing of any damaged areas and replacing areas in which the establishment of the grass stand does not appear to be developing satisfactorily.
- B. Replanting or repair necessary due to the Contractor's negligence, carelessness, or failure to provide routine maintenance shall be at the Contractor's expense.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 03100  
CONCRETE FORMWORK**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.
- B. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts and other items furnished under other Sections and required to be cast into concrete, or approved in advance by the Engineer.

1.02 RELATED WORK

- A. Concrete Reinforcement is included in Section 03200.
- B. Concrete Joints and Joint Accessories are included in Section 03250
- C. Cast-in-Place Concrete is included in Section 03300.
- D. Grout is included in Section 03600.

1.03 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. Form release agent
  - 2. Form ties
- B. Samples
  - 1. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise finished and will not affect the forming materials.
- C. Certificates
  - 1. Certify that form release agent is suitable for use in contact with potable water after 30 days (non-toxic and free of taste and odor).

1.04 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
  - 1. ACI 301 - Standard Specification for Structural Concrete
  - 2. ACI 318 - Building Code Requirements for Reinforced Concrete
  - 3. ACI 347 - Formwork for Concrete



- B. American Plywood Association (APA)
  - 1. Material grades and designations as specified
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.05 SYSTEM DESCRIPTION

- A. General: Architectural Concrete is wall, slab, beam or column concrete which will have surfaces exposed to view in the finished work. It includes similar exposed surfaces in water containment structures from the top of walls to 2-ft below the normal water surface in open tanks and basins.
- B. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL

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

#### 2.02 MATERIALS

- A. Forms for cast-in-place concrete shall be made of wood, metal, or other approved material. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.
- B. Wall Forms
  - 1. Forms for all exposed exterior and interior concrete walls shall be "Plyform" exterior grade plywood panels manufactured in compliance with the APA and bearing the trademark of that group, or equal acceptable to the Engineer. Provide B grade or better veneer on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.
  - 2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging.
- C. Rustication strips shall be at the location and shall conform to the details shown on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth. Rustications and corner strips shall be of a nonabsorbent material,

compatible with the form surface and fully sealed on all sides to prohibit the loss of paste or water between the two surfaces.

D. Form Release Agent

1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water based, bond-breaking form coating unless otherwise noted. Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non-toxic and free of taste or odor and meet the requirements of NSF/ANSI Standard 61. Form release agent shall be Farm Fresh by Unitex or approved equal.

E. Form Ties

1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1-1/2-in of the face of the concrete. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a wood or metal cone at least 1/2-in diameter and 1-1/2-in long. Form ties in concrete exposed to view shall be the cone-washer type.
2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.
3. Flat bar ties for panel forms, if used, shall have plastic or rubber inserts having a minimum depth of 1-1/2-in and sufficient dimensions to permit proper patching of the tie hole.
4. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.
5. Common wire shall not be used for form ties.
6. Alternate form ties consisting of tapered through-bolts at least 1-in in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain Engineer's acceptance of system and spacing of ties prior to ordering or purchase of forming. Clean, fill and seal form tie hole with non-shrink cement grout. A vinyl plug shall be inserted into the hole to serve as a waterstop. The Contractor shall be responsible for water-tightness of the form ties and any repairs needed.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Forms shall be used for all cast-in-place concrete including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions and appearance indicated on the Drawings.
- B. Forms for walls shall have removable panels at the bottom for cleaning, inspection and joint surface preparation. Forms for walls of considerable height shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete

shall be used to allow concrete inspection, to prevent segregation and to prevent the accumulation of hardened concrete on the forms above the fresh concrete.

- C. Molding, bevels, or other types of chamfer strips shall be placed to produce block outs, rustications, or chamfers as shown on the Drawings or as specified herein. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a 3/4-in chamfer. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealants manufacturer's recommendations.
- D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms so that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for the adequacy of the forming system.
- E. Before form material is re-used, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

### 3.02 FORM TOLERANCES

- A. Forms shall be surfaced, designed and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes.
  - 1. Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/16-in and forms for plane surfaces shall be such that the concrete will be plane within 3/16-in in 4-ft. Forms shall be tight to prevent the passage of mortar, water and grout. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-in from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.
  - 2. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.
  - 3. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1-in.

### 3.03 FORM PREPARATION

- A. Wood forms in contact with the concrete shall be coated with an effective release agent prior to form installation.
- B. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those utilized for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

3.04 REMOVAL OF FORMS

- A. The Contractor shall be responsible for all damage resulting from removal of forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347. Form removal shall conform to the requirements specified in Section 03300 and a curing compound applied.

3.05 INSPECTION

- A. The Engineer on site shall be notified when the forms are complete and ready for inspection at least 6 hours prior to the proposed concrete placement.
- B. Failure of the forms to comply with the requirements specified herein or to produce concrete complying with requirements of Section 03300 shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as directed by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of this Section and approval of the Engineer.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 03150  
MODIFICATIONS AND REPAIR TO CONCRETE**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Accessories are included in Section 03250.
- D. Cast-in-Place Concrete is included in Section 03300.
- E. Concrete Finishes are included in Section 03350.
- F. Grout is included in Section 03600.

1.03 SUBMITTALS

- A. Submit manufacturer's technical literature on all product brands proposed for use, to the Engineer for review. The submittal shall include the manufacturer's installation and/or application instructions.
- B. When substitutions for acceptable brands of materials specified herein are proposed, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the project.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
  - 2. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
  - 3. ASTM C883 - Standard Test Method for Effective Shrinkage of Epoxy-Resin Systems Used with Concrete.
  - 4. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
  - 5. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
  - 6. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

7. ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool.
  8. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- B. Where reference is made to one of the above standards, the latest revision as referenced in the FBC shall be used.

#### 1.05 QUALITY ASSURANCE

- A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.
- B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown or specified, line drilling will be required in cutting existing concrete.
- C. **Manufacturer Qualifications:** The manufacturer of the specified products shall have a minimum of 10 years experience in the manufacture of such products and shall have an ongoing program of training, certifying and technically supporting the Contractor's personnel.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification and batch numbers.
- B. Store and condition the specified product as recommended by the manufacturer.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIALS

- A. **General**
  1. Materials shall comply with this Section and any state or local regulations.
- B. **Epoxy Bonding Agent**
  1. **General**
    - a. The epoxy bonding agent shall be a two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bond plastic concrete to hardened concrete complying with the requirements of ASTM C881, Type II and the additional requirements specified herein.
  2. **Material**
    - a. **Properties of the cured material:**

- i. Compressive Strength (ASTM D695): 8500 psi minimum at 28 days.
    - ii. Tensile Strength (ASTM D638): 4000 psi minimum at 14 days.
    - iii. Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days.
    - iv. Shear Strength (ASTM D732): 5000 psi minimum at 14 days.
    - v. Water Absorption (ASTM D570 - 2 hour boil): One percent maximum at 14 days.
    - vi. Bond Strength (ASTM C882) Hardened to Plastic: 1500 psi minimum at 14 days moist cure.
    - vii. Effective Shrinkage (ASTM C883): Passes Test.
    - viii. Color: Gray.
  - 3. Approved manufacturers include: Sika Corporation, Lyndhurst, NJ - Sikadur 32, Hi-Mod; Master Builder's, Cleveland, OH - Concreive Liquid (LPL) or equal.
- C. Epoxy Paste
  - 1. General
    - a. Epoxy Paste shall be a two-component, solvent-free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete such as setting railing posts, dowels, anchor bolts and all-threads into hardened concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3 and the additional requirements specified herein. It may also be used to patch existing surfaces where the glue line is 1/8-in or less.
  - 2. Material
    - a. Properties of the cured material:
      - i. Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
      - ii. Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum.
      - iii. Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 14 days.
      - iv. Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
      - v. Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.
      - vi. Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.
      - vii. Color: Concrete grey.
  - 3. Approved manufacturer's include:
    - a. Overhead applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-mod LV 31; Master Builders, Inc., Cleveland, OH - Concreive 1438 or equal.
    - b. Sika Corporation, Lyndhurst, N.J. - Sikadur Hi-mod LV 32; Master Builders, Inc., Cleveland, OH - Concreive 1438 or equal.



- D. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, Non-Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600 GROUT.
- E. Adhesive Capsule type anchor system shall be equal to the HVA adhesive Anchoring System by Hilti Fastening Systems, Tulsa, OK. The capsule shall consist of a sealed glass capsule containing premeasured amounts of polyester or vinylester resin, quartz sand aggregate and a hardener contained in a separate vial within the capsule. Where the adhesive anchor is under sustained tensile loading (i.e. vertically installed anchors) the anchor system shall be Hilti HIT RE-500 SD by Hilti Fastening Systems, Tulsa, OK.
- F. Acrylic Latex Bonding Agents shall not be used for this project.
- G. Crack Repair Epoxy Adhesive
  - 1. General
    - a. Crack Repair Epoxy Adhesive shall be a two-component, solvent-free, moisture insensitive epoxy resin material suitable for crack grouting by injection or gravity feed. It shall be formulated for the specific size of opening or crack being injected.
    - b. All concrete surfaces containing potable water or water to be treated for potable use that are repaired by the epoxy adhesive injection system shall be coated with an acceptable epoxy coating approved by the FDA for use in contact with potable water.
  - 2. Material
    - a. Properties of the cured material
      - i. Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
      - ii. Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break - 2 to 5 percent.
      - iii. Flexural Strength (ASTM D790 - Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)
      - iv. Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
      - v. Water Absorption (ASTM D570 - 2 hour boil): 1.5 percent maximum at 7 days.
      - vi. Bond Strength (ASTM C882): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.
      - vii. Effective Shrinkage (ASTM 883): Passes Test.
  - 3. Approved manufacturer's include:
    - a. For standard applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod; Master Builders Inc., Cleveland, OH - Concessive 1380 or equal.
    - b. For very thin applications; Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod LV; Master Builders Inc., Cleveland, OH - Concessive 1468 or equal.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Cut, repair, reuse, demolish, excavate or otherwise modify parts of the existing structures or appurtenances, as indicated on the Drawings, specified herein, or necessary to permit completion of the Work. Finishes, joints, reinforcements, sealants, etc, are specified in respective Sections. All work shall comply with other requirements of this of Section and as shown on the Drawings.
- B. All commercial products specified in this Section shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations.
- C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint the repairs shall be made to preserve the isolation between components on either side of the joint.
- D. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

### **3.02 CONCRETE REMOVAL**

- A. Concrete designated to be removed to specific limits as shown on the Drawings or directed by the Engineer, shall be done by line drilling at limits followed by chipping or jack-hammering as appropriate in areas where concrete is to be taken out. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment is not damaged. Sawcutting at limits of concrete to be removed shall only be done if indicated on the Drawings, or after obtaining written approval from the Engineer.
- B. Where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/4-in.
- C. In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the edge of concrete removal shall be a 1-in deep saw cut on each exposed surface of the existing concrete.
- D. Concrete specified to be left in place which is damaged shall be repaired by approved means to the satisfaction of the Engineer.
- E. The Engineer may from time to time direct the Contractor to make additional repairs to existing concrete. These repairs shall be made as specified or by such other methods as may be appropriate.

### 3.03 CONNECTION SURFACE PREPARATION

- A. Connection surfaces shall be prepared as specified below for concrete areas requiring patching, repairs or modifications as shown on the Drawings, specified herein, or as directed by the Engineer.
- B. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry mechanical means, i.e. - sandblasting, grinding, etc, as approved by the Engineer. Be sure the areas are not less than 1/2-in in depth. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete, subject to the Engineer's final inspection.
- C. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc, as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1/2-in. Reinforcing to be saved shall not be damaged during the demolition operation.
- D. Reinforcing from existing demolished concrete which is shown to be incorporated in new concrete shall be cleaned by mechanical means to remove all loose material and products of corrosion before proceeding with the repair. It shall be cut, bent or lapped to new reinforcing as shown on the Drawings and provided with a minimum cover all around as specified on the contract drawings or 2-in.
- E. The following are specific concrete surface preparation "methods" are to be used where called for on the Drawings, specified herein or as directed by the Engineer. All installation of anchors shall be according to the manufacturer's recommendations.
  - 1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly moisten the existing surface with water. Brush on a 1/16-in layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or grout mixture as detailed on the Drawings.
  - 2. Method B: After the existing concrete surface has been roughened and cleaned, apply epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture to limits shown on the Drawings within time constraints recommended by the manufacturer to ensure bond.
  - 3. Method C: Drill a hole 1/4-in larger than the diameter of the dowel. The hole shall be blown clear of loose particles and dust just prior to installing epoxy. The drilled hole shall first be filled with epoxy paste, and then dowels/bolts shall be buttered with paste then inserted by tapping. Unless otherwise shown on the Drawings, deformed bars shall be drilled and set to a depth of ten bar diameters and smooth bars shall be drilled and set to a depth of fifteen bar diameters. If not noted on the Drawings, the Engineer will provide details regarding the size and spacing of dowels.
  - 4. Method D: Combination of Method B and C.

5. Method E: Capsule anchor system shall be set in existing concrete by drilling holes to the required depth to develop the full tensile and shear strengths of the anchor material being used. The anchor bolts system shall be installed per the manufacturer's recommendation in holes sized as required. The anchor stud bolt, rebar or other embedment item shall be tipped with a double 45 degree chamfered point, securely fastened into the chuck of all rotary percussion hammer drill and drilled into the capsule filled hole.

3.04 GROUTING

- A. Grouting shall be as specified in Section 03600.

3.05 CRACK REPAIR

- A. Cracks on horizontal surfaces shall be repaired by gravity feeding crack sealant into cracks per manufacturer's recommendations. If cracks are less than 1/16-in in thickness they shall be pressure injected.
- B. Cracks on vertical surfaces shall be repaired by pressure injecting crack sealant through valves sealed to surface with crack repair epoxy adhesive per manufacturer's recommendations.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 03200  
CONCRETE REINFORCEMENT**

**PART 1 - GENERAL**

1.01 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.
- B. Furnish only all deformed steel reinforcement required to be entirely built into concrete masonry unit construction.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Cast-in-place Concrete is included in Section 03300.

1.03 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.
  - 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.

1.04 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
- A. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## 1.02 QUALITY ASSURANCE

- E. 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.

## 1.05 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.

## **PART 2 - PRODUCTS**

### 2.01 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.

## 2.02 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.

## **PART 3 - EXECUTION**

### **3.01 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.

### 3.02 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.

### 3.03 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.

### 3.04 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.

3.05 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**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 03250**  
**CONCRETE JOINTS AND JOINT ACCESSORIES**

**PART 1 - GENERAL**

1.01 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.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Cast-In-Place Concrete is included in Section 03300.
- D. Concrete Finishes are included in Section 03350.
- E. Grout is included in Section 03600.

1.03 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.

#### 1.04 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.

### **PART 2 - PRODUCTS**

#### 2.01 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.

#### 2.02 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. 732 or approved equal for construction 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.; Coneresive 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.

## **PART 3 - EXECUTION**

### **3.01 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 sawcutting.
  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**

**PART 1 - GENERAL**

1.01 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.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Joint Accessories are included in Section 03250.
- D. Concrete Finishes are included in Section 03350.
- E. Grout is included in Section 03600.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data including the following:
  - 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.
- B. Samples
1. Fine and coarse aggregates if requested by the Engineer.
- C. 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.
- D. 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).

#### 1.04 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.

#### 1.05 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.

#### 1.06 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.

## **PART 2 - PRODUCTS**

### 2.01 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. Cement: U.S. made portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work. The following cement type(s) shall be used:

### 2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: Domestic portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work. The following cement type(s) shall be used:
  - 1. Class A,B,C,D Concrete - Type II with the addition of fly ash resulting in  $C_3A$  being below 5 percent of total cementitious content, Type III limited to 5 percent  $C_3A$  or Type V.
- 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).

## 2.03 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 7 to 10-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.

### PART 3 - EXECUTION

#### 3.01 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.

### 3.02 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

<u>Air or Concrete Temperature (whichever is higher)</u>	<u>Maximum Time</u>
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.

3.03 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.

### 3.04 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 7-ft and the maximum free fall of concrete shall not exceed 15-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.

### 3.05 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. 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.

3.06 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 30 percent of its specified design strength, 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

(See definition of degree-days in Paragraph 3.05D above).

- 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.

### 3.07 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.

### 3.08 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.

### 3.09 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

<u>Class</u>	<u>Design Strength (psi)</u>	<u>Description</u>
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavements
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 FINISHING**

**PART 1 - GENERAL**

1.01 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.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Cast-In-Place Concrete is included in Section 03300.
- C. Grout is included in Section 03600.

1.03 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.

1.04 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.

1.05 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.

## **PART 2 - PRODUCTS**

### **2.01 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 "Kure-N-Seal", by Sonneborn, Minneapolis, MN or equal.

## **PART 3 - EXECUTION**

### **3.01 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.

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.

### 3.02 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.

### 3.03 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.

### 3.04 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.

### 3.05 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**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 03600  
GROUT**

**PART 1 - GENERAL**

1.01 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.

1.02 RELATED WORK

- A. Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Joint Accessories are included in Section 03350.
- D. Cast-in-Place Concrete is included in Section 03300.

1.03 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.

1.04 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.

1.05 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.

#### 1.06 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.

#### 1.07 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.

### **PART 2 - PRODUCTS**

#### 2.01 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.

#### 2.02 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.

## **PART 3 - EXECUTION**

### **3.01 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 effect 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.

### 3.02 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.

### 3.03 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.

### 3.04 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.

### 3.05 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.

### 3.06 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 06615**  
**FIBERGLASS REINFORCED PLASTIC COMPONENTS**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install the fiberglass reinforced plastic (FRP) guard rails, grating, platform, stairs and support system and as specified herein.

1.02 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete shop drawings of all FRP products specified herein. Submit shop drawings and calculations for FRP platforms and stairs sealed by a licensed professional engineer. Submittals shall indicate construction details, sizes, thicknesses of sections, profiles, attachments, dimensions and field joints, method of support from structure, work to be built-in or provided by other sections and finishes to conform to the Drawings and this Section. Indicate connections, both shop and field. Submittals shall include the following:
  - 1. Strength tests, physical properties, dimensions, chemical resistance tests and material composition.
  - 2. Manufacturer's certification that materials meet specification requirements.
- B. Certified test data based on tests of actual production samples which demonstrate that the products conforms to the stress and deflection requirements specified herein.

1.03 REFERENCE STANDARD

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM E84 - Standard Test Methods for Surface Burning Characteristics of Building Materials
  - 2. ASTM D349 - Standard Test Methods for Laminated Round Rods Used for Electrical Insulation.
  - 3. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
  - 4. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - 5. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
- B. Occupational Safety and Health Administration (OSHA)
- C. American Iron and Steel Institute (AISI)
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.04 QUALITY ASSURANCE

- A. The fiberglass reinforced plastic components manufacturers shall be experienced in the manufacture of items of similar size and quality and shall present proof as required of successful installations involving the items under similar conditions to this project.
- B. The work of this Section shall be completely coordinated with the work of other sections. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- C. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other sections.

#### 1.05 DESIGN CRITERIA

- A. The design of FRP products shall be in accordance with OSHA structural guidelines, ASTM standard testing procedures and generally accepted structural design practice.
- B. The design of FRP products shall be the responsibility of the manufacturer and shall be acceptable to the Engineer.
- C. Specific design criteria for individual components or structures shall be in accordance with OSHA 29 CFR 1910 Subpart D and as follows:
  - 1. The designed FRP Gratings shall meet the following loading requirements. In addition to the dead load, the FRP gratings shall be capable of supporting a uniform live load of 200 psf while maintaining a deflection of less than 0.25-in or  $L/360$ , whichever is smaller. The gratings shall also be capable of supporting a concentrated live load of 500 lbs applied over a 12-in by 1-in area at the midpoint of the spans indicated on the Drawings.
  - 2. The designed FRP stairs and platform shall meet the following loading requirements. In addition to the dead load, the FRP platform shall be capable of supporting a uniform live load of 100 psf while maintaining a deflection of less than 0.25-in or  $L/360$ , whichever is smaller.
  - 3. Factor of safety shall be 5 based on ultimate stress. Grating shall be a minimum of 2-in deep, and have either a T-bar or rectangular bar shape.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIALS AND PROPERTIES

- A. Resin for FRP components shall be an acceptable vinyl ester, integrally resistant without applied coatings to ultra-violet radiation; to high concentrations of hydrogen sulfide gas, its solutions and associated compounds and to the wastewater occurring at the project site.
- B. Provide compatible and equally resistant resin as acceptable for shop and field sealing of cut edges.

- C. Minimum physical properties for pultruded structural FRP shapes and plates shall be as follows:
  - 1. Tensile Strength (coupon): 30,000 psi - ASTM D638
  - 2. Tensile Strength (full section in bending): 20,000 psi at 75 degrees F
  - 3. Modulus of Elasticity: 2.3 x 10<sup>6</sup> psi at 75 degrees F, 1.8 x 10<sup>6</sup> psi at 125 degrees F - ASTM D790
  - 4. Barcol Hardness - 50
  - 5. Water Absorption - 0.75 percent (by weight) - ASTM D349
  - 6. Specific Gravity - 1.66 - ASTM D792
- D. FRP components shall have integral colors acceptable to the Engineer selected from standard resin colors.
- E. Stainless Steel
  - 1. Shapes - AISI Type 304
  - 2. Fasteners and components - Type 18-8.

## 2.02 GRATING

- A. FRP grating shall be Duradek by AFC Inc., Chatfield MN, similar by Imco Reinforced Plastics Inc., Moorestown NJ; Chemgrate Corp., Woodinville WA or equal.
- B. Outer surfaces, cut edges, or any surfaces that are exposed to air during cure shall be finished so as to obtain complete cure of the resin without air inhibition by coating the surface after initial cure with resin containing paraffin. Softening or tackiness of any surface under an acetone test will be considered evidence of incomplete cure.
- C. I-bar shaped FRP grating shall be constructed of straight parallel bearing bars and composed of a glass fiber and thermosetting resin pultruded composite. The bearing bars to be placed edgewise and joined by structural crossties every 12-in, maximum. Crossties shall be 3/8-in diameter fiberglass rod with glass fiber reinforced plastic or stainless steel ferrules and polypropylene spacers. The upper bar surface shall have a coarse quartz/epoxy grit surface to provide skid resistance.
- D. Rectangular shaped FRP grating shall be constructed of straight parallel bearing bars and cross bars composed of glass fiber and resin, compression molded at high temperatures and pressure. No dry glass fibers shall be visible on any surface of bearing bars or cross bars. Bearing bars shall be spaced on 1-in centers and cross bars spaced on 6-in centers. Top surfaces shall have grit surface for skid resistance.
- E. Provide structural FRP angle frames, structural support shapes, grit impregnated plate where required and appurtenances as shown.
- F. Angle frames shall be continuous around the opening in order to present an even and flat support for the grating except as otherwise shown. The angles and anchors shall be as detailed.



- G. FRP grating shall be securely attached to supporting members and angles. Attachment to FRP supporting members shall be either stainless steel or FRP with stainless steel fasteners. Each grating panel shall be attached to supporting members at a minimum of four locations (two each edge). All materials and incidentals required for attaching grating to angle frame and supports shall be furnished and installed under this Section.
- H. Coordinate the layout of grating panels with work of other Sections to provide openings for approved mechanical equipment, operators, gates and other items which require penetrations or openings in the grating. Grating panels shall be further subdivided and supported to provide maximum panel weight of 75 lbs.

#### 2.03 HANDRAILING

- A. FRP handrailing shall be Duradek Handrail System by AFC Inc, or similar by Imco or Chemgrate. System shall withstand a 300 lb. load applied at any point, in any direction to the top rail with a maximum deflection of L/360.
- B. System shall be composed of FRP tubes with a two square inch cross-section areas; solid FRP connector plugs fitting snugly inside the tubes; solid ½-in diameter FRP connector rods; and flattened corrugated 1/8-in thick, 4-in high FRP kickplates with ½-in deep corrugations and stainless steel drive rivets for fastening to posts.
- C. Fabricate with continuous posts and toprail, with intermediate rails cut between posts.

#### 2.04 STRUCTURAL SHAPES

- A. Structural shapes shall be pultruded Extren by Morrison Molded Fiberglass Co., Bristol, VA or equal.

### **PART 3 - EXECUTION**

#### 3.01 FABRICATION AND SHIPPING

- A. All FRP grating and supports shall be designed and fabricated by a single manufacturer.
- B. FRP grating panels and structurals shall be shipped banded onto skids and covered with plywood to minimize shipping damage.

#### 3.02 INSTALLATION

- A. All components shall be installed in full accordance with the Drawings, the final shop drawings and manufacturer's recommendations by mechanics skilled in the installation of this type of work.
- B. All FRP shall be installed securely and shall be level and true to line.

**END OF SECTION**

**SECTION 09900  
PAINTING AND COATING**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials; equipment and incidentals required to provide a protective or aesthetic coating system for the surfaces listed herein and not otherwise excluded. All surfaces described, whether new or existing, shall be included within the scope of this section.
- B. The work includes painting and finishing of interior and exterior process related items and surfaces. The omission of minor items in the schedule of work shall not relieve the Contractor of his obligation to include such items where they come within the general intent of the Specifications as stated herein.
- C. The following major process items shall be painted:
  - 1. Any exposed surfaces of ferrous metal or galvanized components of process equipment. This excludes stainless steel components.
  - 2. Any exposed surfaces of PVC components of pipe, fittings, valves, electrical conduits, or equipment.
  - 3. Any exterior surfaces of exposed metallic piping, fittings, and valves located in either the interior or exterior of the process building. This excludes stainless steel components.
  - 4. Any embedded aluminum, or aluminum in contact with dissimilar metals.
- D. The following items of the Project shall not be painted:
  - 1. Any code-required labels, equipment identification, performance rating, name, or nomenclature plates, or signage.
  - 2. Any moving parts of operating units, mechanical and electrical parts unless otherwise indicated.
  - 3. Any stainless steel components.
  - 4. Any products with polished chrome, aluminum, nickel, or stainless steel finishes.
  - 5. Any flexible couplings, lubricated bearing surfaces, insulation, or metal and plastic pipe interiors.
  - 6. Any plastic switch or receptacle plates.
  - 7. Any finish hardware.
  - 8. Any galvanized metal components.

## 1.02 RELATED WORK

- A. Section 09905 – Piping, Valve, and Equipment Identification System
- B. Section 15070 – Polyvinyl Chloride (PVC) Pipe and Fittings
- C. Section 15100 – Valves and Appurtenances
- D. Drawings S01 and S02 contain requirements for structural coatings.

## 1.03 DEFINITIONS

- A. The term “Paint” as used herein refers to all coating systems, materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials used as prime, intermediate, or finish coats.

## 1.04 REFERENCES

### A. OSHA

- 1. 1926 Subpart C - General Safety and Health Provisions
- 2. 1926 Subpart D - Occupational Health and Environmental Controls
- 3. 1926 Subpart E - Personal Protective and Life Saving Equipment
- 4. 1926 Subpart F - Fire Protection and Prevention
- 5. 1926 Subpart H - Materials Handling, Storage, Use, and Disposal
- 6. 1926 Subpart Z - Toxic and Hazardous Substances

### B. The Society for Protective Coatings

- 1. SSPC-SP1 - Solvent Cleaning
- 2. SSPC-SP5 - White Metal Blast Cleaning
- 3. SSPC-SP6 - Commercial Blast Cleaning
- 4. SSPC-SP7 - Brush-Off Blast Cleaning
- 5. SSPC-SP10 - Near White Metal Blast Cleaning

## 1.05 QUALITY ASSURANCE

- A. Provide the best quality grade of the various types of coatings as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer’s identification as a standard, best-grade product will not be acceptable.
- B. Holiday Testing: Each coat shall be holiday tested at the recommended 100-125 volts DC per mil in accordance with the latest edition of the following standards: NACE SP0188-2006, NACE Standard RP0490, ASTM G62
- C. Provide undercoat paint produced by the same manufacturer as the finish coats. Where undercoat(s) are not specified, undercoat(s) shall be provided in accordance with the coating manufacturer’s recommendations at no additional cost to the Owner. Undercoat and finish coat paints shall be compatible. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

- D. Painting shall be accomplished by experienced painters specializing in industrial painting and familiar with all aspects of surface preparations and applications required for this project.
- E. All surface preparation, coating, and materials shall comply with the SSPC recognized standards.

#### 1.06 SUBMITTALS

- A. Submittals shall include manufacturer's data and samples as indicated below and shall be prepared and submitted in time to provide adequate review by the Engineer.
- B. Samples:
  - 1. Paint colors will be selected by the Engineer with final approval by the Owner. Compliance with all other requirements is the exclusive responsibility of the Contractor.
  - 2. Samples of each finish and color shall be submitted to the Engineer for approval before any work is started.
  - 3. Samples shall be prepared so that an area of each sample indicates the appearance of the various coats. For example, where three coat work is specified, the sample shall be divided into three areas: one showing application of one coat only, one showing the application of two coats, and the third showing the application of three coats.
  - 4. Such samples when approved in writing shall constitute a standard, as to color and finish only, of acceptance or rejection of the finish work.
  - 5. For piping, valves, equipment, and miscellaneous metal work, provide sample chips or color charts of all paint selected showing color, finish, and general characteristics.
  - 6. Rejected samples shall be resubmitted until approved.

#### 1.07 DELIVERY, HANDLING, AND STORAGE

- A. Deliver all materials to the job site in original, unopened packages and containers bearing the manufacturer's name and label.
  - 1. Provide labels on each container with the following information:
    - a. Name or title of material
    - b. Fed. Spec. number if applicable
    - c. Manufacturer's stock number and date of manufacture
    - d. Manufacturer's formula or specification number
    - e. Manufacturer's batch number
    - f. Manufacturer's name
    - g. Generic type
    - h. Contents by volume, for major pigment and vehicle constituents

- i. Thinning instructions
    - j. Application instructions
    - k. Color name and number
  2. Containers shall be clearly marked to indicate any hazards connected with the use of the paint and steps which should be taken to prevent injury to those handling the product.
- B. All containers shall be handled and stored in such a manner as to prevent damage or loss of labels or containers.
- C. The Engineer shall designate areas for storage and mixing of all painting materials.
- D. Contractor must comply with the requirements of the pertinent codes and fire regulations when handling all materials. Proper containers outside of the building shall be provided by the Contractor and used for painting wastes. No plumbing fixtures shall be used for this purpose.
- E. All used rags shall be removed from buildings every night and every precaution shall be taken to prevent spontaneous combustion of flammable materials.

## **PART 2 - PRODUCTS**

### 2.01 MATERIALS

- A. All paint used shall be manufactured by one of the following:
1. Tnemec Company, Inc.,
  2. Carboline,
  3. or, PPG Amercoat.
- B. All paint used shall be of the highest grade regularly manufactured.
- C. Coating systems included in this specification are identified by name in order to establish a standard of quality. Other products of the same generic type may be submitted to the Engineer for review. When a coating system other than that specified herein is proposed, the Contractor shall submit a typed list giving the proposed coatings, brand, trade name, generic type, and catalog number of the proposed system for the Engineer's review.
- D. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to the underlying paint.
- E. Emulsion and alkyd paints shall contain a mildewcide and both the paint and mildewcide shall conform to OSHA and Federal requirements, including Federal Specification TT-P-19.
- F. All rags associated with this work shall be clean painters' rags, and be completely sterilized.

## 2.02 COATING SYSTEMS

### A. Metals, Non-Immersion, Interior/Exterior

1. Surfaces shall include interior and exterior metal surfaces that do not come in direct contact with corrosive materials or atmospheres and shall include the following:
  - a. Aboveground piping, fittings, valves, and metal electrical conduit.
  - b. Miscellaneous steel plates, shapes, hardware, etc.
  - c. Galvanized steel surfaces.
  - d. Other surfaces obviously requiring field coating, including equipment where equipment specification requires coating, or as specified to be field coated in Section 09905: Piping, Valve, and Equipment Identification System.
2. Surfaces shall be prepared as specified in Paragraph 3.01 herein and, in addition, the following:
  - a. All bare metals or areas that were shop primed that have been damaged shall be abrasive blast cleaned to SSPC-SP6, commercial blast cleaning standards.
  - b. Shop primed items, stored on site for a prolonged period prior to coating, shall be prepared for coating following the coating manufacturer's recommendations prior to applying touch-up and subsequent coats. Surface preparation may include brush-off abrasive blasting or spot blasting to SSPC-SP6, commercial blast cleaning standards, for areas where the primer has been damaged and bare metal is showing.
  - c. Non-ferrous metals shall be degreased and cleaned in compliance with SSPC-SP1 for solvent cleaning.
3. The prime coat for metals shall be a two-part epoxy polyamide primer, 3 - 5 mils DFT; Color Hi-Build Epoxoline II Series N69 by Tnemec, Carboguard 888 by Carboline, or Amerlock 400 by PPG Amercoat.
4. The intermediate coat shall be a two-part epoxy polyamide, 4 - 6 mils DFT; Color Hi-Build Epoxoline II Series N69 by Tnemec, Carboguard 888 by Carboline, or Amerlock 400 by PPG Amercoat.
5. The finish coat shall be a two-part aliphatic acrylic polyurethane 2.5 – 4 mils DFT minimum; Endura-Shield II Series 1075 by Tnemec, Carbothane 133LH by Carboline, or Amercoat 450HSG by PPG Amercoat.
6. Total minimum system finish coating thickness shall be 10 - 15 mils DFT.

### B. Metals, Containment Area

1. Submerged Metal: Refer to drawing No. S02. Tnemec or equal by Carboline or PPG Amercoat.

### C. Metals, Buried

1. Buried Metal: Refer to Section 15065 and Section 15100.
- D. Plastic Piping, Valves, Fittings, and Conduit
1. Surfaces include the following:
    - a. PVC piping, fittings, valves, and electrical conduits requiring color coding in accordance with Section 09905.
    - b. Exposed exterior plastic piping, valve, and fitting components subject to UV degradation and weathering by the elements. Coat all above grade PVC piping except on the pump skids.
  2. The surfaces shall be prepared as specified in Paragraph 3.01 herein, including cleaning and washing with detergent to remove all dirt and foreign material, and light surface abrasion using medium grade sandpaper. Remove dust, dirt and debris with clean rags prior to coating.
  3. The prime and finish coats shall be Enduratone Series 1028 by Tnemec, Sanitile 120 (prime) and Carbocrylic 3359 (finish) by Carboline, or Amercoat 220 by PPG, three (3) coats total, 2 - 3 mils DFT per coat.
  4. Total minimum system finish coating thickness shall be 6 - 9 mils DFT.
- E. Concrete, Chemical Resistant
1. Surfaces include interior portions of the sodium hypochlorite containment structure including the chemical feed system area including floors, walls, and sumps.
  2. Surfaces shall be prepared in accordance with coating manufacturer's recommendations and Drawing No. S02.
  3. Refer to Drawing No. S02 for coating system by Tnemec, or equal by Carboline or PPG Amercoat.

### **PART 3 - EXECUTION**

#### **3.01 SURFACE PREPARATION**

- A. In addition to the aforementioned preparations, all dirt, rust, scale, splinters, loose particles, disintegrated paint, grease, oil, and other deleterious substances shall be removed from all surfaces which are to be coated.
- B. Hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces and not to be painted shall be removed, masked, or otherwise protected prior to surface preparation and painting operations.
- C. Before commencing work, the painter must make certain that the surfaces to be covered are in perfect condition. Should the painter find such surfaces unacceptable, he shall report the condition to the Engineer. The application of paint shall be held as an acceptance of the surfaces and working conditions and the painter will be held responsible for the results reasonably expected from the materials and processes specified.

- D. Program the cleaning and painting so contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.
- E. Clean ferrous substances, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning. All welds, blisters, etc. shall be ground and sanded smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting.
- F. Surface profile as obtained from sandblasting shall be as recommended by the coating manufacturer.

### 3.02 MATERIALS PREPARATION

- A. Mix and prepare painting materials in strict accordance with the manufacturer's recommendations and directions. Materials should be stirred prior to and during application to maintain a mixture of uniform density, free of film, dirt, and other foreign materials.
- B. No thinners shall be used except those specifically mentioned by the manufacturer, and only in such quantities as directed by the manufacturer's instructions. If thinning is used, sufficient additional coats shall be applied to assure the required dry film thickness is achieved. The manufacturer's recommended thinner or clean-up solvent shall be used for all clean-up.

### 3.03 APPLICATIONS

- A. Application by brush, spray, airless spray, or roller shall be as recommended by the manufacturer for optimum performance and appearance.
- B. Color Selection for Color Coding:
  - 1. Color Coding of Piping: All exposed piping shall be identified as specified in Section 09905. Pipe identification system shall include color coding or banding, legends, and arrows.
  - 2. Color Coding of Conduit: All exposed electrical conduit with conductors over 120 volts shall be color banded as specified in and Section 09905.
- C. All painting shall be done by skilled and experienced craftsmen and shall be of the highest quality workmanship.
- D. Apply paint in accordance with the manufacturer's directions. Use applications and techniques best suited for the type of material being applied.
- E. All paint shall be at room temperature and the surfaces to be painted shall be dry and clean.
- F. Comply with manufacturer's recommendations and as indicated herein as to the environmental conditions under which coatings and coating systems can be applied. The conditions below shall be adhered to even if manufacturer's recommendations are less stringent. If manufacturer's recommendations are more stringent, they shall apply.



1. No coatings shall be applied when the air, surface, and material temperature is below 55°F or above 95°F for 24 hours prior to and 24 hours after coating application. Surface temperature shall be at least 5°F above the dew point for 24 hours prior to and 24 hours after coating application. The dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Weather Bureau psychometric tables. Do not apply coatings when the relative humidity exceeds 85 percent or to damp or wet surfaces, unless otherwise permitted by the coating manufacturer's printed instructions. No painting shall be done when the surfaces may become damaged by rain, fog or condensation or when it is anticipated that these conditions will prevail during the drying period, unless suitable enclosures to protect the surface are used. Before painting each day and periodically during the day, confirm in the Owner's presence that the atmosphere temperature and humidity are acceptable for products being applied. The Contractor shall fill out and sign a form for each test performed to maintain a record of acceptable conditions during painting or coating activities.
2. Where heat is necessary, it shall be supplied by the painting applicator and shall be of such type that it will maintain an air and coated surface temperature of 55°F minimum prior to and after the coating application as described above, and 90°F minimum during the cure stage if hot air forced curing is recommended by the coating manufacturer for special coatings. Further, this heater shall be of such type as not to contaminate the surface area to be or being coated with combustion products. The Contractor shall supply utilities to run electric or gas heaters. Any surface coating damaged by moisture or rain shall be removed and redone as directed by the Owner or Engineer.
3. Do not apply finish in areas where dust is being or will be generated during application through full cure.
4. All exterior painting shall be done only in dry weather. Any surface coating damaged by moisture or rain shall be removed and redone.
5. Spray application shall occur only when wind velocities, including gusts, are less than 10 miles per hour. All materials, equipment, etc. in the vicinity of spray application shall be protected from overspray.
6. Application of materials shall be done only on properly prepared surfaces as herein specified. Between any two coats of material, unless specifically covered in the coating manufacturer's most recent printed application instructions, if more than one (1) week passes between subsequent coats, the coating manufacturer will be contacted for his recommended preparation of the surface prior to application of the next coat. This preparation might include brush-off blasting, steam cleaning, or solvent wiping (with an indicated solvent) and shall be specified in writing by the material supplier and followed by the applicator. Any surface coating damaged by moisture or rain shall be removed and redone as directed by the Owner or Engineer.

7. In no case shall paint be applied to surfaces which show a moisture content greater than 14 percent. The presence of moisture shall be determined prior to coating by testing with a moisture detection device such as a Delmhorst Model DLM2E.
- G. The minimum coating thicknesses shall be as follows:
1. Coating thickness shall meet or exceed the specified minimum dry film thickness (DFT) in all areas. The average coating thickness as determined by multiple representative DFT measurements shall meet or exceed the mid-point of DFT range. If below this DFT value, the surface shall be recoated with at least the minimum DFT until the total DFT meets or exceeds the mid-point DFT.
  2. Coverage rates are theoretical as calculated by the coating manufacturer and are, therefore, the maximum allowable.
  3. Apply a prime coat to material which is required to be painted or finished, and which has not been prime coated by others.
  4. On porous or rough surfaces, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.
- H. Apply a prime coat to material which is required to be painted or finished, and which has not been prime coated by others.
- I. Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Apply additional coats when undercoats, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color, and appearance.
- K. Paint shall be applied in a neat manner with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness.
- L. Paint surfaces behind moveable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
- M. Sand lightly between each succeeding enamel or varnish coat.
- N. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise specified.
- O. The prime and intermediate coats as specified for the various coating systems may be applied in the shop by the manufacturer. The shop coats shall be of the type specified and shall be compatible with the field coat or coats. Such shop-painted items as pumps, motors, equipment, etc. shall be given at least one touch-up coat with the intermediate coat material and one complete finish coat in the field.

### 3.04 MINIMUM COATING THICKNESS

- A. Coatings shall be applied in accordance with the manufacturer's recommendations. Minimum coating millage shall be as specified above.

### 3.05 FINISHES

- A. Pigmented (Opaque) Finishes: Completely cover to provide opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks runs, sags, ropiness, or other surface imperfections will not be acceptable.
- B. Complete Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specific requirements.

### 3.06 FIELD QUALITY CONTROL

- A. All completed surfaces will be checked by the Engineer, and the Contractor shall provide the necessary properly calibrated gauges. All non-ferrous surfaces shall be checked for film thickness by use of a Tooke gauge. All ferrous surfaces shall be checked for film thickness by use of an Elcometer or Micro-Test magnetic dry film gauge, properly calibrated. In addition, submerged tank linings and metals shall be tested for freedom from holidays and pinholes by use of a Tinker-Rason or K-D Bird Dog Holiday Detector.
- B. The presence of moisture shall be determined prior to coating by testing with a moisture detection device such as a Delmhors Model DB.
- C. All defects shall be corrected to the satisfaction of the Engineer.

### 3.07 PROTECTION

- A. All other surfaces shall be protected while painting equipment, piping, etc.
- B. Protection of furniture and other movable objects, equipment, fittings, and accessories shall be provided throughout the painting operation. Remove all electrical plates, surface hardware, etc. before painting. Protect and replace such items when painting is completed.
- C. Mask all machinery nameplates and all machined parts not to receive paint prior to coating.
- D. Lay drop cloths in all areas where painting is being done to adequately protect structures, flooring, piping, equipment, and other work from all damage.

### 3.08 CLEANING

- A. The Contractor shall perform the work under this Section while keeping the premises free from accumulation of debris and rubbish, and shall remove all scaffolding, paint cloths, paint, and brushes from buildings and project site when painting is completed.
- B. All paint brushed, splattered, spilled, or splashed on any surface not specified to be painted shall be removed.

3.09 EXTRA STOCK

- A. Upon completion of painting work, the Owner shall be furnished at no additional cost, one gallon of each type and color of finish paint for touching up. Paint container labels shall be complete with the manufacturer's name, generic type, number, color, and location in which the paint was applied.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 09905**  
**PIPING, VALVE, AND EQUIPMENT IDENTIFICATION SYSTEM**

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. Scope of Work

1. The work included under this Section consists of providing an identification system for piping systems and related equipment.

B. Related Work Described Elsewhere:

1. Underground Piping and Fittings are included in Section 15065.

C. General Design

1. Piping color codes, and code labels for pipe identification shall conform to Table 09905-1 included in this section.
2. Pipelines, equipment, or other items which are not listed here shall be assigned a color by the Owner and shall be treated as an integral part of the Contract.
3. Color coding shall consist of color code painting and identification of all exposed conduits, through lines and pipelines for the transport of gases, liquids, or semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and any operating accessories which are integral to a whole functional mechanical pipe and electrical conduit systems.
4. All moving parts, drive assemblies, and covers for moving parts which are potential hazards shall be Safety Red.
5. All safety equipment shall be painted in accordance with OSHA standards.
6. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. If the equipment and/or appurtenances have been assigned another color, the pipe system shall be painted with the pipe color up to, but not including, the flanges attached to pumps and mechanical equipment assigned another color.
7. All hangers and pipe support floor and accessories stands shall be painted to match their piping. The system shall be painted up to, but not including, the face of flanges or the flexible conduit connected to electrical equipment. Structural members used solely for pipe hangars or supports shall be painted to match their piping. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the

contact surface of the metals shall be coated in accordance with Section 09 90 01.

8. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to, but not including, the face of flanges or connections on the equipment.
9. System code lettering and arrows shall conform to the requirements of ANSI A 13.1 marked on piping as follows:
  - a. Legends shall be of the following color for the respective pipe color:

<u>Key to Classification of Predominant Colors For Piping</u>	<u>Color of Letters, if not otherwise specified</u>
(F) Fire Protection: Red	White
(D) Dangerous: Yellow	Black
	Black
(S) Safe: Green	Black
	Black
	White
	Black
	Black
	White
	Black
(P) Protective: Blue	White

1.02 QUALITY ASSURANCE

- A. All work shall be in accordance with ANSI Standard A13.1, Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Submit manufacturer's descriptive literature, illustrations, specifications, and other pertinent data.

B. Schedules:

1. Provide a typewritten list of all tagged valves giving tag color, shape, letter code and number, the valve size, type, use, and general location.
2. Provide a complete list of materials to be furnished and surfaces on which they will be used.

C. Samples:

1. Provide a sample of each type valve tag supplied.
2. Provide a sample of each type of identification tape supplied.
3. Provide manufacturer's color charts for color selection by Engineer.

1.04 DELIVERY, STORAGE, AND HANDING

A. Except for locally mixed custom colors, deliver sealed containers with labels legible and intact.

B. Materials shall be stored as follows:

1. Store only acceptable project materials on project site.
2. Store in suitable location.
3. Restrict storage to paint materials and related equipment.
4. Comply with health and fire regulations.

**PART 2 - PRODUCTS**

2.01 PIPING AND VALVE IDENTIFICATION

A. Above ground piping shall be identified by self-adhesive pipe markers equal to those manufactured by W. H. Brady Company or an approved equal.

1. Markers shall be of wording and color as shown in Table 09905 - 1 included in this Section.
2. Lettering shall be:
  - a. 2 1/4-inches high for pipes 3 inches diameter and larger.
  - b. 1 1/8-inches high for pipes less than 3 inches diameter.
3. Flow arrows shall be:
  - a. 2 1/4-inches by 6 inches for pipes 3 inches diameter and larger.
  - b. 1 1/8-inches by 3 inches for pipes less than 3 inches diameter.



B. Buried piping shall be identified by electronic marker balls, a continuous, insulated copper wire, and identification tape.

1. Marking Tape:

a. During the backfilling operating, pipe-locating tape shall be placed directly above and parallel to the pipe run with the printed side up for visual identification. Marking tape shall consist of a 2-inch minimum width plastic and metallized foil for detection by pipeline locating equipment. The tape shall be coded as follows:

<b>Marking Tape Properties</b>		
<b>Pipe</b>	<b>Color</b>	<b>Printing</b>
Potable Water	Blue	Caution Buried Water Line Below
Reclaimed Water	Purple	Caution Buried Reclaimed Water Line Below
Sodium Hypochlorite	Yellow	Caution Buried Sodium Hypochlorite Below

b. Marking Tape will be manufactured by Lineguard Inc., of Wheaton, IL; or approved equal.

2. Locating Wire: All pressure mains shall be installed with a continuous color-coded insulated 10 gauge solid core copper wire as shown in the Drawings.

C. A coded and numbered tag attached with SS 316 chain and/or SS 316 "S" hooks shall be provided on all valves.

1. Tags for valves on pipe shall be SS 316 or anodized aluminum. Colors for aluminum tags shall, where possible, match the color code of the pipe line on which installed.

2. In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the valve service and number. All color and letter coding shall be approved by the Engineer. Valve service shall either be as listed in Table 09905 - 1 included in this Section, or by equipment abbreviation if associated with a particular piece of equipment. Valve numbering, if required, shall be as approved by the Engineer and/or Owner.

D. Buried valves shall have valve boxes protected by a concrete pad. The concrete pad for the valve box cover shall have a 3-inch diameter, bronze disc embedded in the surface as shown on the Drawings. The bronze disc shall have the following information neatly stamped on it:

1. Size of valve, inches

2. Type of valve:

a. GV - Gate Valve

- b. BFV - Butterfly Valve
  - c. PV - Plug Valve
- 3. Valve Service - See Table 09905 - 1 for abbreviations
  - 4. Number of turns to fully open
  - 5. Direction to open
  - 6. Year of installation

## 2.02 EQUIPMENT IDENTIFICATION

- A. All equipment shall have nametags in accordance with Section 15000.

## **PART 3 - EXECUTION**

### 3.01 PREPARATION

- A. Unless otherwise indicated or specifically approved, all fabricated equipment shall be shop primed and finished.
- B. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- C. Where specified in other sections of these specifications for mechanical equipment, the Contractor shall apply field coat or coats of paint in accordance with Section 09900. If shop finish coat is unsatisfactory due to poor adhesion or other problems with primer or finish coats, coatings shall be removed and replaced by sandblasting, priming and finishing in accordance with Section 09900 and this Section.
- D. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned. Equipment contaminated by grit in critical areas, such as bearings, gears, seals, etc., shall be replaced at no cost to the Owner.

### 3.02 INSTALLATION

- A. Identification tape shall be installed for all buried lines in accordance with the manufacturer's installation instructions and as specified herein.
- B. Identification tape for piping shall be installed one (1) foot directly above and parallel to the pipe with the printed side up for visual identification.
- C. Locating wire shall be provided as shown on the drawings.
- D. An arrow indicating direction of flow shall be placed adjacent to each marker.

- E. The bronze valve identification disc for buried valves shall be embedded in the concrete pad surrounding the valve box.

TABLE 9905 – 1 COLOR CODES AND ABBREVIATIONS

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Potable Water	PW	Blue	Black
Sodium Hypochlorite	SH	Yellow	Black
Electrical Conduit	--	Interior: Match adjacent wall or equipment color. Exterior: Grey	--

NOTE: Other piping shall be painted as directed by the Engineer.

**END OF SECTION**

**SECTION 11345  
SODIUM HYPOCHLORITE FEED SYSTEM**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: The CONTRACTOR shall provide all labor, materials, services, equipment and incidentals, required to furnish, install, test and place in satisfactory operation, the sodium hypochlorite feed system as shown on the Drawings and specified herein. This Section includes:
1. Sodium hypochlorite chemical metering pump skids complete with appurtenances.
- B. Related Work Specified Elsewhere:
1. Section 13300, Process Instrumentation and Control System.
  2. Section 15070, Schedule 80 Polyvinyl Chloride (PVC) Pipe and Fittings
  3. Division 16, Electrical.

1.02 QUALITY ASSURANCE

- A. Manufacturer Responsibility: All equipment required under this specification shall be supplied by a single supplier who shall assume responsibility for the adequacy and performance of all the equipment.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. American Society for Testing and Materials (ASTM).
  2. American National Standards Institute (ANSI).
  3. National Electric Code (NEC).
  4. Standards of National Electrical Manufacturers Associations (NEMA).
  5. Anti-Friction Bearing Manufacturers Association (AFBMA).
  6. Institute of Electrical and Electronic Engineers (IEEE).
  7. American Gear Manufacturer's Association (AGMA).
- C. Metering Pump Manufacturer's Field Services:

1. Retain factory trained representative of the metering pump manufacturer with demonstrated ability and experience in the installation and operation of the metering pumps to perform the services listed below:
  - a. Inspect the completed installation and prepare an inspection report.
  - b. Test, calibrate and adjust all components for optimum performance.
  - c. Assist in initial start-up and field testing.
  - d. Instruct OWNER's personnel in the operation and user maintenance of all components. Conduct a training seminar at the site.
  - e. Supervise the correction of any defective or faulty work before and after acceptance by OWNER.

### 1.03 SUBMITTALS

#### A. Shop Drawings: Refer to Section 01340. Provide the following:

1. Manufacturer's literature, catalog cuts and specifications for metering pumps and accessories showing dimensions, materials of construction and performance data.
2. Schematics, wiring diagrams, and installation details.
3. Drawings of the duplex metering pump skid with scale and dimensions.

#### B. Operation and Maintenance Manuals

1. Operation and Maintenance Manuals: Submit complete installation, operation and maintenance manuals including copies of all approved shop drawings as required by Section 01730, Operating and Maintenance Data.
2. Required Maintenance Data: Maintenance data shall include all information and instructions required by plant personnel to keep equipment properly lubricated and adjusted so that it functions economically throughout its full design life. Name, address, and phone number of manufacturer and manufacturer's local service representative.

### 1.04 DELIVERY, STORAGE AND HANDLING

- #### A. The equipment provided under this section shall be shipped handled and stored in accordance with the manufacturer's written instructions and in accordance with Section 01600.

### 1.06 WARRANTY AND GUARANTEES

- #### A. Provide equipment (system) warranties per Section 01740: Warranties and Bonds.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. All wetted surfaces of metering pumps and appurtenances, and all sealing gaskets shall be suitable for continuous exposure to sodium hypochlorite (10-15 percent solution, maximum specific gravity = 1.23).

### 2 SODIUM HYPOCHLORITE CHEMICAL SOLUTION METERING PUMPS

B. Sodium Hypochlorite Metering Pumps:

1. The System supplier shall furnish seven (7) skid-mounted sodium hypochlorite metering pumps for dosing sodium hypochlorite solution. An existing 3-pump skid will be relocated from its current location as Phase II system and will be dedicated to Phase I/II for Prefilter and Filter Effluent tank injection location. Three (3) pumping systems shall be dedicated to Phase III for Pre-Flocculation, Chlorine Contact Tank 3, and Chlorine Contact Tank 4. Two (2) pumping systems shall be dedicated to Phase V for Prefilter and Chlorine Contact Tank 5. Two (2) pumping systems shall be spare standby (SB) units. Each pump skid will house one (1) metering pump. The metering pumps are sized such that the maximum required dosage can be achieved with two (2) pumps operating. The Phase I/II pumps are rated to pump a maximum of 92.5 gallons per hour (gph) each at 58 psi. The Phase III and V metering pumps will each be capable of pumping a range of 2 to 120 gallons per hour (gph) at 50 psi.
2. The pumps shall be horizontal, positive displacement, diaphragm metering pumps, capable of the following:
  - a. Turndown ratio of 60:1 minimum.
  - b. Full stroke length with suction stroke speed independently adjustable from the discharge stroke speed.
  - c. Analog speed control
  - d. 120 VAC, 60 Hz, single phase.
  - e. PVDF pump head.
  - f. Ball check valves. Disc check valves will not be accepted.
3. Each metering pump shall be specifically designed to meet the full range of sodium hypochlorite concentrations and its vapors and automatically evacuate air and vapors from the pump head during operation. Metering pumps shall be Grunfos Alldos DME #940, Prominent Sigma 3, or Milton Roy maxRoy B.

C. Metering Pump Skid:

1. All pumps shall be mounted on skids as shown on the Drawings. The skids shall be piped and valved according to the P&IDs.
2. The pump system skids shall be complete and shall contain the chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The skids shall contain the following:
  - a. PVC or Polypropylene skid with drip lip.
  - b. Metering pump and motor.
  - c. Pump controller.
  - d. Calibration column.
  - e. Pulsation dampener.
  - f. Back pressure valve
  - g. Pressure gauges with diaphragm seals.
  - h. Ball valves.
  - i. Flushing inlet and outlets
  - j. Pressure relief valve.
  - k. Strainer.
  - l. Magmeter.
  - m. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within two inches of the edge of skid. Electrical cables shall terminate in the control panel.
3. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the project location on a single skid. Items to be mounted on the skid are as indicated on the Drawings. These shall include the metering pump, calibration column, piping valves, piping accessories, and wiring integral to the skid. The chemical feed system supplier shall be responsible for providing all equipment, valves, and piping within the skid boundary.
4. The skids shall be constructed of fusion welded PVC or polypropylene sheets of minimum ½-inch thickness with adequate supports for all equipment and piping. Fork lift truck cut outs and anchor bolt holes shall be provided. Clear acrylic spray shield and doors shall be provided with each skid.
5. All components of the skid mounted system (pumps, piping, and controls) shall be tested prior to shipment. All materials shall be suitable for respective chemical service.
6. System supplier shall furnish the seven (7) sodium hypochlorite metering pumps in (7) pre-assembled single metering pump skids (seven metering pumps total) with all required electrical equipment, piping, valves, fittings, and appurtenances for dosing sodium hypochlorite as indicated on the drawings.

7. Metering pump skid suction piping shall be 3” in size and will include a degassing riser and calibration column.
8. Metering pump skid discharge piping shall be 1” in size and will include a pulsation dampener, back pressure/anti-siphon valve, manual pressure gauge with isolator for each metering pump.
9. Skid piping shall be Schedule 80 PVC. Cement shall be as specified in Section 15070.
10. Ball valves shall be furnished. Cross connection valves shall be furnished as per P&IDs. Isolation valves shall be provided at all equipment connections. Valve materials shall match adjacent piping material.
11. An adjustable (0 – 150 psi) external pressure relief valve shall be installed on the pump discharge header set as recommended by pump manufacturer. The relief shall discharge to pump suction header.
12. A gas charged pulsation dampener shall be provided and sized for a minimum of 90% dampening. Pulsation dampener shall include gas charge fitting and pressure gauge. The dampener shall be installed in the discharge piping of each metering pump, as close to the metering pump discharge check valve as possible. All materials shall be compatible with sodium hypochlorite.
13. A back pressure valve shall be provided in the discharge piping of each metering pump to provide a constant back pressure at the chemical metering pump discharge. The back pressure valve shall be fully adjustable from 0 – 150 psi with body compatible with sodium hypochlorite, Teflon diaphragm and have no metal parts in contact with the chemical.
14. A 2-inch liquid filled gauge shall be furnished on the discharge of each pump, and shall be protected by a glycerin filled gauge protector with Teflon diaphragm. The casings of the gauge shall be 316 stainless steel and accuracy shall be 2% or better.
15. Provide a magmeter with PVDF body and electrodes, HDPE housing, Viton o-rings, and PVC adapters. Magmeter shall be Seametrics PE 102-075 NEMA 4X with FT 420 rate and total flow indicator.
16. All metering pump skid electrical enclosures, connections and components shall be NEMA 4X rated.
  - a. The NEMA 4X FRP terminal junction box (TJB) shall be provided on the skid back panel for termination of all wiring. A power outlet with in-use weatherproof cover shall be provided for any metering pumps, or accessories that require an outlet. The outlet(s) shall be factory wired to the TJB in non-metallic flexible conduit and be fed from the protected side of the AC surge arrestor. All signal and control cables shall be neatly ran to the TJB and terminated using NEMA 4X cable



grips and landed to terminals for field connections. For all devices with multiple cables, the cables shall be bundled in a single protective nylon overbraid. The inside cover of the terminal box shall include a wiring diagram detailing the function of all terminals. A power disconnect switch or breaker shall be provided in the terminal junction box. Surge protection shall be provided locally in the skid mounted terminal junction box. Protection shall be provided for the main power supply as well as all analog input and output signals. Surge protection devices shall be as manufactured by EDCO Inc. of Florida. The NEMA 4X TJB shall provide the following I/O at a minimum:

- Terminals for 120VAC power (local heavy duty surge protection included).
  - 15A Breaker for Main AC Power.
  - HOA Selector Switch for each pump.
  - DI = Remote On/Off for each pump.
  - AI = Remote Speed Reference for each pump (local surge protection included)
  - DO = Run Status for each pump
  - DO = Remote Status for each pump
  - DO = Fault Status for each pump
  - AO = Flow Rate from Magnetic Flow Meter (local surge protection included)
17. A spare parts and maintenance kit shall be supplied for the metering pumps and skid.
18. Skids shall be manufactured by Blue Planet Environmental Systems Inc., Guardian Equipment Inc., or Engineer approved equal.

#### D. Spare Parts

1. Provide the following spare parts to the OWNER for each chemical metering skid upon delivery of the pump skid. Spare parts shall include all parts required for (2) years of normal maintenance of all components of the chemical metering system. All parts shall be in one box labeled with the Skid ID Information:
  - a. (1) maintenance kits for each chemical metering pump. Maintenance kits shall include but not be limited to diaphragm, check valve seats, gaskets and o-rings.

- b. (3) maintenance kits total for a pressure relief valve.
- c. (3) maintenance kits total for a back pressure valve.
- d. (3) spare bladders total for a pulsation dampener.
- e. (2) spare valves for each pump skid.
- f. (1) Parts list for all serviceable components.

## 2.02 SODIUM HYPOCHLORITE FEED PIPING

### A. Suction Piping and Accessories:

- 1. Suction piping and fittings shall be Schedule 80 PVC, NSF approved for sodium hypochlorite in accordance with the Specifications.
- 2. Calibration column shall be a 4000 mL clear PVC calibration column with a 1" threaded base and a removable top.
- 3. Valves shall be Schedule 80 PVC solvent welded, socket end, double-union, vented ball valves with Viton O-rings, PTFE seats, and Viton backing cushions, Type 21 by Asahi-America or approved equal.

### B. Discharge Piping and Accessories

- 1. Discharge piping and fittings shall be Schedule 80 PVC, NSF approved for sodium hypochlorite solution in accordance with the Specifications.
- 2. Valves shall be Schedule 80 PVC solvent welded, socket end, double-union, vented ball valves with Viton O-rings, PTFE seats, and Viton backing cushions, Type 21 by Asahi-America or approved equal.

### C. Fastening System

- 1. A non-corrosive vinyl ester and PVC fastening system shall be used to secure sodium hypochlorite solution piping and tubing to the skids.

## **PART 3 - EXECUTION**

### 3.01 INSPECTION

- A. Inspect all equipment immediately upon delivery to site. All surfaces shall be smooth, free of voids and porosity, without dry spots, crazes or unreinforced areas. If damaged, notify OWNER'S representative and manufacturer at once.
- B. Do not install damaged equipment until repairs are made in accordance with manufacturer's written instructions and approved by the OWNER'S representative. Only minor repair work shall be permitted in the field. All other damaged items shall be sent to factory for repair or replacement.

### 3.02 INSTALLATION

- A. Install equipment in conformance with manufacturer's instructions.
- B. Metering pumps and stand shall be secured in accordance with the manufacturer's recommendations.
- C. Support piping independent of pump.
- D. Pump installations shall include furnishing and applying an initial supply of any lubricants recommended by the manufacturer.
- E. Make all electrical connections in conformance with the requirements of Division 16, Electrical.
- F. Metering Pump Manufacturers Field Services:
  - 1. Retain factory trained representatives of the metering pump manufacturer with demonstrated ability and experience in the installation and operation of the metering pumps to perform services per 1.02.C. above.

### 3.03 START-UP, TESTING, AND INSTRUCTION

- A. Make adjustments necessary to place equipment in optimum operating condition.
- B. Test the sodium hypochlorite feed system for proper operation in the presence of the OWNER'S representative.
- C. Furnish all testing equipment and devices required.
- D. If the sodium hypochlorite feed system fails to meet any of the specified performance requirements, CONTRACTOR shall modify and/or replace defective equipment until it meets specified requirements. Re-test system to verify satisfactory operation.
- E. Demonstrate and document accuracy and calibration of each metering pump using job supplied calibration chamber.

**END OF SECTION**

**SECTION 13209  
POLYETHYLENE STORAGE TANKS**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. This section includes provisions for the complete installation of Lined Cross-Linked Polyethylene Chemical Storage Tanks with a low density linear added liner and appurtenances as shown in the Contract Drawings and as specified herein.

1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.
1. Section 01340 – Submittals
  2. Section 01730 – Operating and Maintenance Data
  3. Section 01740 – Warranties and Bonds
  4. Section 01650 – Start-Up and Demonstration
  5. Section 11345 – Chemical Feed Systems
  6. Section 15070 – Schedule 80 Polyvinyl Chloride (PVC) Pipe and Fittings

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01340, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:
- B. Shop drawings
1. Dimensions of tank, fittings and attachments
  2. Wall thickness calculations per ASTM D 1998-97 using 600 psi design hoop stress @ 100 degrees F
  3. Locations of fittings and attachments
  4. Resin used and a complete manufacturer's specification of the resin used
  5. Weight of tanks
  6. Statement that fabrication is in accordance with these Specifications
  7. Instructions for handling, storage and installation of tanks
  8. Statement that materials and resins used are suitable for intended service
- C. Manufacturer's certificates
- D. Operation and maintenance manuals and manufacturer's instructions in accordance with Section 01730.

E. Samples.

1. Representative samples of the Lined Crosslinked Polyethylene with low density polyethylene liner tank shall be furnished at the time of shop drawing review. These samples shall be from plant production and shall be representative of quality and impact resistance of tanks to be furnished. The Engineer may reject any tank that does not meet the standard of the representative samples.

F. References

1. Submit to Engineer a list of 10 similar use installations in the past 5 years with names and phone numbers of references.

1.04 REFERENCES

A. Design, manufacturing and assembly of elements of the products herein specified shall be in accordance with the standards of the below listed organizations.

1. American Society for Testing Materials (ASTM)
  - a. ASTM D638 - Standard Test Method for Tensile Properties of Plastics
  - b. ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact
  - c. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  - d. ASTM D883 - Standard Definitions of Terms Relating to Plastics
  - e. ASTM DI 505 - Density of Plastics by the Density-Gradient Technique
  - f. ASTM D1525 - Vicat Softening Temperature of Plastics
  - g. ASTM D1693 - ESCR Spec. Thickness 0.125" F50 -10% Igepal
  - h. ASTM D1998 - Standard Specification for Polyethylene Upright Storage Tank: Section 11.3: Low Temperature Impact Test and Section 11.4: Oxylene-Insoluble Fraction (Gel Test)
2. American Water Works Association (AWWA)
3. Hydraulic Institute Standards
4. American National Standards Institute (ANSI)
  - a. ANSI B16.5 - Pipe Flanges and Flanged Fittings.

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.05 SYSTEM DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required to install, field test, complete, and make ready for service three (3) vertical storage tanks designed for use with bulk sodium hypochlorite as shown on the Contract Drawings and as specified herein.

- B. This specification section provides requirements for sodium hypochlorite storage tanks.
- C. The tanks will be used to store bulk sodium hypochlorite liquid as specified herein, with normal producer impurities for indefinite periods on site until used.
- D. Flange faces shall be protected from damage. All openings are to be covered to prevent the entrance of dirt and debris.
- E. Nozzles or other fittings shall not be used for lifting. Manway may be used for lifting only if recommended by manufacturer and only according to procedures submitted by manufacturer. Handling of tank when filled is not allowed.
- F. Friction tank pad shall be provided for the storage tank.
- G. Instructions shall be provided for unloading and installation of tanks.

1.06 PERFORMANCE REQUIREMENTS OR CONDITIONS

- A. All components of the liquid chemical storage tanks shall be capable of normal operations and shall be compatible with the following chemical solutions:

	<b>Sodium</b>
<b>Chemical Formula</b>	NaOCl
<b>Concentration Trade Percent</b>	10 - 15%
<b>Specific Gravity</b>	1.2

B. The High Density Crosslinked Polyethylene tanks shall be designed for the following:

	<b>Sodium Hypochlorite</b>
<b>Tank Description</b>	Vertical w/ IMFO
<b>Tank Outer Diameter (max.)</b>	10 ft, 2 in
<b>Overall Height (max.)</b>	16 ft
<b>Primary Tank</b>	Lined Crossed-linked Polyethylene
<b>Nominal Capacity</b>	7,300 gallons
<b>Tank Design Specific Gravity</b>	1.9
<b>Number of Tanks</b>	3

C. The Tanks shall be rated for 120 mph wind speed and include galvanized steel hurricane restraints or equivalent anchoring device to meet wind load requirements.

1.07 QUALITY ASSURANCE

- A. All the equipment specified under this Section shall be furnished by a single manufacturer, and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.
- B. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.
- C. These Specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation, field testing and field calibration of all materials and apparatus as required. Any additional equipment necessary for the proper operation of the proposed installation not specifically mentioned in these Specifications or shown on the Drawings shall be furnished and installed at no change in Contract Price or Time.

1.08 DELIVERY AND STORAGE

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variations; dirt and dust; or other contaminants in accordance with the manufacturer's recommendations.

1.09 WARRANTY

- A. The Contractor shall warrant the tanks to be free from defects in materials and workmanship and to be suitable for the applications and chemicals as specified in these specifications.
- B. The supplier shall warranty the tank against side wall failure for a period of 5-years from the date of shipment, and all accessories for a period of 1-year from beneficial use.

**PART 2 - PRODUCTS**

2.01 MANUFACTURER

- A. The Chemical Storage Tanks manufacturer shall be the following or Engineer approved equal:
  - 1. PolyProcessing Company, Monroe, LA
  - 2. Chem-tainer Industries, Inc., Babylon, NY
  - 3. US Plastic Corp, Lima, Ohio

2.02 MANUFACTURED UNITS

- A. Plastic

The tanks shall be molded from High Density Crosslinked Polyethylene. The resin used shall be Paxon 7204 or approved equal.
- B. Fillers and Pigments

The plastic shall not contain any fillers. All plastic shall contain a minimum of 0.25% U.V. stabilizer and maximum of 0.60%. Pigments may be added as desired by the Owner or as designated by the manufacturer, not to exceed 0.5% of dry blended or 2% if melt compound of the total weight of the tank. Tanks shall be black in color.
- C. Linear Crosslinked Polyethylene Tanks
  - 1. The Lined Crosslinked Polyethylene tanks shall be constructed by the rotational molding process.
  - 2. The Lined Crosslinked Polyethylene tanks shall be capable of storing sodium hypochlorite, at 100 degrees F.
  - 3. The Lined Crosslinked Polyethylene bulk storage tanks shall have an integrally molded flanged outlet (IMFO), providing full drainage capability and eliminating hole penetrations in the lower tank sidewall for optimal long term performance, safety, and environmental protection.



4. The storage tanks shall be vertical, cylindrical, flat bottom, dome top, and seamless in construction. The interior wall shall be lined with an anti-oxidant sodium hypochlorite-resistant polyethylene resin. The dimension details, and accessories shall be shown on drawings and specifications herein.
5. The minimum wall thickness shall be ¼ inches in all places.
6. All edges cut out, such as entrance manways, shall be trimmed to have smooth edges.
7. Schedule 80 PVC bulkhead fittings with Viton gaskets for the tank vent and fill line shall be installed by the Manufacturer.
8. An overflow fitting comprised of a one-piece polyethylene male threaded spool and interior backing ring with anchored encapsulated titanium bolts, Viton full-face gasket, Van stone exterior PVC backing ring, and titanium washers and nuts shall be installed by the Manufacturer.

D. Piping

1. Each tank shall have a PVC flanged butterfly valve and a flanged PTFE flexible bellows installed on the outlet of the tank isolation valve. Refer to Section 15100.
2. All chemical feed system piping shall be installed by a Florida licensed master plumber, Odyssey Manufacturing Company or equal.
3. Piping shall be Sch. 80 PVC.

2.03 ACCESSORIES

A. The Lined Cross-linked Polyethylene tanks shall be equipped with the following accessories:

1. The top hinged and weighted manway cover on the sodium hypochlorite shall be at least 24-inches inside diameter. Cover shall have a relief vent that opens at 6-inches water column. Manway gasket shall be polyethylene. Bolts used on the cover shall be made from a material chemically resistant to sodium hypochlorite.
2. Level Gauge:
  - a. Each tank shall include a reverse float level indicator.
3. Fittings: All openings (fittings) shall be made from materials chemically resistant to sodium hypochlorite.
4. Each tank shall have a 3-way cable restraint system.
5. Each tank shall have a FRP access ladder with rails, platform, and return for access to the hatch. Ladder and platform shall be sufficiently rigid to run from floor mounts to tank attachment points.
6. Each tank shall have a 2" PVC universal ball dome fitting for an ultra-sonic level sensor.

7. Sidewall: Tanks shall use integrally molded flanged outlets. Sidewall fittings shall keep the stored chemical from contacting the tank wall cross section. The tank discharge piping shall be reduced using a PVC eccentric reducer in order to preserve the full drain benefit of the IMFO fitting.
8. Tank Fittings: All fittings shall be PVC. All tank sidewall fittings shall have litharge Viton gaskets. All tank dome fittings shall have EPDM gaskets. All hardware on sodium hypochlorite tanks shall be titanium except for the IMFO ring, which shall be PVC. Tank fittings shall be supplied and installed by tank manufacturer.
9. Venting: Atmospheric pressure must be maintained in the tank at all times. A 4-inch minimum U-vent with 24-mesh vinyl bug screen located in the center of the tank dome.
10. Furnish and install all precautionary labeling as recommended by the Manufacturing Chemists Association for each of the chemicals to be stored.
11. Furnish and install friction pad under each tank

#### 2.04 SHOP TESTING

- A. The tank manufacturer shall have quality control procedures adequate to insure that all fabrications comply with these Specifications. Quality control shall include in process inspections as well as a final inspection by the manufacturer and written record of these inspections. The objective of manufacturer's quality control and inspection procedure shall be to have the tank comply with the Specifications and Drawings at the time of the first inspection, thus eliminating any need for rework by the manufacturer or a second inspection by the Engineer.
- B. Inspection records shall be made for each tank. Inspection records shall be available to the Engineer. Upon request, manufacturer shall send a copy of his inspection records to the Engineer for review prior to inspection by the Engineer.
- C. Final acceptance by the Engineer may be contingent upon satisfactory inspection upon arrival, the delivery and installation at the job site.
- D. The tank manufacturer shall perform the tests described below prior to shipping. Test samples shall be taken from the cut our areas of where fittings are inserted in each tank. The Engineer or representative shall have the option of witnessing these factory tests.
  1. Impact Test: Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank
  2. Degree of Crosslinking Test: ASTM 1998-Section 11.4 shall be used in this test. A minimum of 60 percent Gel must be obtained per ASTM D-1998.
  3. Hydrostatic Test: Each tank shall be filled with water and checked for leaks no less than thirty minutes after filling.

4. Wall Thickness: Each tank shall have an actual wall thickness measurement taken at every 90 degrees, at each one foot elevation, up to three feet from the bottom of the tank.

#### 2.05 PAINTING

- A. Surface preparation, shop painting, field painting and other pertinent detailed painting specifications shall be in accordance with Section 09900 – Painting.

### **PART 3 - EXECUTION**

#### 3.01 INSTALLATION

- A. The equipment shall be installed in accordance with the instructions of the manufacturer, and the Contract Documents.

#### 3.02 TESTING

- A. Field tests shall be made in conformance with Section 01650.
- B. Preliminary field tests shall be made after installation of the chemical storage tanks. Final field tests shall demonstrate the following:
  1. That the units have been properly installed and are in proper alignment
  2. That there are no mechanical defects in any of the parts
  3. After installation, each tank, connecting pipes, and valving shall be field tested by filling with water. The tank and fittings shall hold water without loss, evidence of weeping or capillary action for a period of 24 hours prior to acceptance. The Engineer may also inspect each tank for defects, damage, and conformance with the specifications.
  4. After testing, the tanks shall be thoroughly cleaned and dried.
  5. Should any defects become evident during inspection, testing, or within the guarantee period, the Contractor shall repair or replace the defective tank or fitting as approved by the Engineer.
- C. Final acceptance will be dependent upon the satisfactory operation and performance after installation.

#### 3.03 MANUFACTURER'S SERVICES AND CERTIFICATES(S)

- A. Provide manufacturer's (or supplier's) services according to Section 01730.
- B. The Contractor shall arrange for the manufacturer to furnish the services of a qualified representative as necessary to check the equipment installation; to supervise the final acceptance test and the initial operation; and to instruct the Owner's operator in operations, proper maintenance and repairs.
- C. Equipment manufacturer shall provide a written report covering his findings and installation approval. The report shall include description of all inspections and any deficiencies noted and shall be mailed directly to the Engineer.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 13300  
PROCESS INSTRUMENTATION AND CONTROL SYSTEM**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. Work includes engineering, furnishing, installing, programming, testing, documenting and placing in operation a Programmable Logic Controller (PLC) based Process Control Panel (PCP) for monitoring and control of new sodium hypochlorite systems at Orange County, Florida's Eastern Water Reclamation Facility (EWRF). Modification of the existing Plant Control System to incorporate the new PCP and process equipment is also included.
- B. It is the ultimate responsibility of the CONTRACTOR to furnish a complete and fully operable system that reliably performs the specified functions. However, it is the intent of these Contract Documents that a single entity (henceforth referred to as the SYSTEM SUPPLIER) be retained by the CONTRACTOR to have overall responsibility for designing, furnishing, interfacing, adjusting, testing, documenting, and starting-up the equipment described in the Contract Documents.
- C. The work defined in this Specification Section shall be performed by the following listed below and henceforth referred to as the SYSTEM SUPPLIER.
  - 1. Curry Controls, Lakeland, Florida
  - 2. Revere Control Systems
  - 3. Controls Instruments, Inc.
  - 4. Approved equal
- D. The CONTRACTOR shall be responsible for:
  - 1. Equipment storage and protection until installed following the storage and handling instructions recommended by the SYSTEM SUPPLIER. Anti-static and winterization requirements shall be per the SYSTEM SUPPLIER's instructions and the SYSTEM SUPPLIER shall periodically verify that these instructions are followed.
  - 2. Including within the electrical subcontractor's scope the provision, installation and termination of field and power wiring to the PCP. Termination shall be made in accordance with final accepted interconnection diagrams developed by the SYSTEM SUPPLIER. The electrical subcontractor shall mark on the interconnect diagram the field wire numbers used for each termination point. The SYSTEM SUPPLIER shall finalize the interconnect diagrams by including these field wire numbers in the final as built version.
- E. All engineering development required by the SYSTEM SUPPLIER will be in accordance with the Conditions of this Contract.

- F. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.
- G. In the bid price, the SYSTEM SUPPLIER shall provide for obtaining the services of authorized field personnel from the manufacturers of components or systems provided under this section but not manufactured by the SYSTEM SUPPLIER. Should these personnel be required during installation, start-up and checkout of the PCP, such services shall be provided at no additional cost to the OWNER.

#### 1.02 RELATED WORK

- A. All conduits, power and field wiring and cables are provided and installed under Division 16.

#### 1.03 SUBMITTALS

- A. Furnish, as prescribed under the General Requirements, all required submittals covering the items included under this section.
- B. Submit complete, neat, orderly, and indexed submittal packages. Handwritten diagrams are not acceptable and all documentation submittals shall be made using CADD generated utilities.
- C. Partial submittals or submittals that do not contain sufficient information for complete review or are unclear will not be reviewed and will be returned by the ENGINEER as not approved.
- D. Provide all shop drawing submittals on disk in PDF format.
- E. Provide a single shop drawing submittal containing the following:
  - 1. Loop diagrams, consisting of complete wiring and/or plumbing diagrams for each control loop showing all terminal numbers, the location of the dc power supply, the location of any booster relays or common dropping resistors, surge arrestors, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus divide each loop diagram into four areas for identification of element locations: PLC I/O point(s), panel face, back-of-panel, and field, respectively.
  - 2. System interconnect diagram that shows all connections required between component parts of the items covered in this section and between the various other systems specified in this Contract. Number all electrical terminal blocks and field wiring. Identify each line at each termination point with the same number. Do not use this number again for any other purpose in the complete control scheme.
  - 3. Bill of Materials: A list of all components, including all 3<sup>rd</sup> party software. Group components by type and include component model number and part number, component description, quantity supplied, and reference to component catalog information.

4. Descriptive Information: Catalog information, descriptive literature, performance specifications, internal wiring diagrams, power and grounding requirements, power consumption, and heat dissipation of all elements. Clearly mark all options and features proposed for this project.
  5. Installation Details. Equipment installation drawings showing external dimensions, enclosure material and spacing, mounting connections, and installation requirements.
  6. A list of, and descriptive literature for, spares, expendables, and test equipment.
- F. Test Procedures: Submit the procedures proposed to be followed during all system testing. Procedures shall include test descriptions, forms, and check lists to be used to control and document the required tests.
- G. Test Reports: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures to the ENGINEER.

#### 1.04 FINAL DOCUMENTATION

- A. After the demonstration tests have been completed and as a part of the final acceptance requirements, submit the system record drawings. Record drawings shall include, corrected for any changes that may have been made up through Substantial Completion:
1. instrument loop wiring diagrams
  2. panel wiring diagrams
  3. panel elevations
  4. interconnection diagrams showing terminal numbers at each wiring termination
- B. Record drawings shall be developed or converted to the latest version of AutoCAD. Provide two copies of all AutoCAD files on separate Compact Disks.
- C. Operating and Maintenance (O&M) Manuals: Provide the specified number of complete sets of three-ring bound O&M manuals in accordance with Division 1. Include descriptive material, drawings, and figures bound in appropriate places. Include:
1. Cross references to any 3<sup>rd</sup> party O&M manuals.
  2. Additional operating and maintenance instructions in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration and maintenance of each component provided.
  3. All the submittal data for each component from the approved shop drawing submittals with corrections made on approved as noted items.



4. A Compact Disk containing the shop drawing data in PDF format in the binder sleeve.
- D. Provide the following additional final documentation:
1. Licenses in the OWNER's name for all software supplied including software used for PLC & OIT programming.
  2. Final copies of all programming files on Compact Disk.
  3. A complete printout of all "Annotated" PLC program logic.

#### 1.05 QUALITY CONTROL

- A. The SYSTEM SUPPLIER shall be subcontracted by and paid by the CONTRACTOR.
- B. The SYSTEM SUPPLIER shall meet all of the requirements of these specifications, and, unless specifically stated otherwise, no prior acceptance of any subsystem, equipment, or materials has been made.
- C. All equipment furnished by the SYSTEM SUPPLIER shall be of the latest and most recent design and shall have overall accuracy as guaranteed by the manufacturer.
- D. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.
- E. Component equipment shall be as supplied by one of the manufacturers named or approved equal. The design of the system is based on the first-named manufacturer's equipment if there is a difference.
- F. To facilitate the OWNER's operation and maintenance, products shall be of the same major MANUFACTURER, with panel mounted devices of the same type and model as far as possible.
- G. In order to insure the interchangeability of parts and the maintenance of quality, strict compliance with the above requirements shall be maintained.
- H. The SYSTEM SUPPLIER shall designate a single point of contact for interface with the ENGINEER on this project. The ENGINEER reserves the sole right to approve or reject this point of contact.
- I. The SYSTEM SUPPLIER shall provide experienced personnel on-site to coordinate and/or perform installation, termination, and adjustment; on-site testing; OWNER training; and startup assistance for the system.

#### 1.06 STANDARDS

- A. The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this Contract.

- B. International Society of Automation (ISA) and National Electrical Manufacturers Association (NEMA) standards shall be used where applicable in the design of the system.
- C. Any equipment that does not have a UL, FM CSA, or other approved testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electric Code and OSHA requirements.
- D. Any additional work needed resulting from any deviation from codes or local requirements shall be at no additional cost to the OWNER.

#### 1.07 WARRANTY AND GUARANTEES

- A. In accordance with Division 1, the SYSTEM SUPPLIER shall furnish to the OWNER a written two year guarantee commencing with substantial completion, that all equipment and parts thereof, material and/or workmanship are of top quality and free from defects.
- B. The SYSTEM SUPPLIER shall guarantee all equipment whether or not of his own manufacture.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS

- A. Equipment to be installed in a hazardous area shall meet Class, Group, and Division classification as shown on the Contract Electrical Drawings, or comply with the local or National Electrical Code, whichever is the most stringent requirement.
- B. All components supplied shall be of the MANUFACTURER's latest design and shall produce or be activated by signals, which are established standards for the water and wastewater industries.
- C. Electronic equipment shall utilize printed circuitry suitably coated to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.
- D. All equipment shall be designed to operate on a 60-Hertz alternating current power source at a normal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
- E. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a

single MANUFACTURER, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion through the installation of plug-in circuit cards or additional cabinets.

- F. The equipment furnished shall be designed to operate satisfactorily between 0 degrees C and 40 degrees C at up to 95 percent Relative Humidity (non condensing).
- G. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 volts-amperes (VA), unless specifically noted otherwise.
- H. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

## 2.02 LEVEL TRANSMITTER

- A. The system shall consist of a loop-powered sensor (Level Transmitter, LT) that uses a non-contact 26 GHz radar measurement technique to measure the liquid level in a vessel, tank or basin. The transmitter shall be configurable to convert the level into a flow or volume reading for various standard weirs and vessels.
- B. System Performance:
  - 1. Overall system accuracy shall be plus or minus 0.2 percent of span
  - 2. Operating temperature range: -40 to 80 degrees C.
  - 3. Measurement range: 15 inches to 40 feet.
- C. Materials:
  - 1. Aluminum housing.
  - 2. Tefzel antenna.
- D. Power Requirement – 16 to 36 Volts DC.
- E. Manufacturer, Model series:
  - 1. Magnetrol model R82.
  - 2. No equal.

## 2.03 LEVEL SWITCH, FLOAT

- A. The level switch shall be a direct acting, weighted float suspended on its own cable. As the liquid level rises the float tilts and actuates a hermetically sealed mercury switch inside the float. The cable shall be terminated within a junction box located outside the tank or basin. For multiple float applications, all cables shall terminate in a single junction box.
- B. Materials:
  - 1. Float wetted part – Polypropylene

2. Cable – PVC jacketed
  3. Junction box – 316 SS
- C. Ratings:
1. Junction box – NEMA 4X
- D. Electrical:
1. Dry contact rated to 4.5 Amps at 120 VAC
  2. Normally open or normally closed as required for the application
- E. Options
1. Provide stainless steel supports/mounting accessories as required.
- F. Manufacturer, model:
1. Per Orange County Utilities – Appendix D- List of approved products.

#### 2.04 PROCESS CONTROL PANEL

- A. General:
1. All conduit entry shall be from the top and/or bottom only.
  2. The panel shall be provided with an isolated copper grounding bus to ground all signal shield connections.
  3. The panel shall be a ventilated NEMA 4X, Type 316 stainless steel enclosure with 30% spare mounting space for future, additional equipment. The enclosure shall have provisions for padlocking the door and a dead front inner door unit for mounting controls. All exterior hardware and hinges shall be stainless steel
  4. The panel shall be equipped with an internal, hand-switch controlled, 40-watt fluorescent light and 120V, 15 amp, duplex utility receptacle. These shall be serviced through a dedicated breaker.
  5. The panel shall be protected from internal corrosion by the use of corrosion – inhibiting vapor capsules. Provide:
    - a. Northern Instruments Model Zerust VC-6-2
    - b. Hoffman, model A-HC15E
    - c. Approved equal.
- B. Finish:
1. All front panel openings for panel-mounted equipment shall be cut with counter-boring and provided with trim strips as required to give a neat finished appearance.

2. All steel panel surfaces shall be treated with phosphatized treatment inside and out, and then finished on the exterior with two coats of baked enamel of the approved color. Interiors of panels shall be white, ANSI No. 51.
- C. Doors:
1. All control panels shall have a continuous piano hinge door for ease of access. A minimum of 80% of the panel interior shall be exposed by doors.
  2. The inside of each door shall be equipped with a print pocket.
  3. Two-door enclosures shall have a removable center post.
- D. Nameplates:
1. All front-face panel mounted controls shall be equipped with screw mounted laminated plastic nameplates to completely define their use.
  2. All internal components shall be equipped with identification tags
- E. Power Supplies.
1. An Uninterruptible Power Supply (UPS) shall be provided as follows:
    - a. Size the UPS for all internal equipment.
    - b. Provide 15 minutes battery back-up capability at full load.
    - c. Provide Invensys Powerware Ferrups or approved equal.
  2. Provide isolated 24 Volt DC power supplies as follows:
    - a. Redundant supplies with separately fused connections to power the PLC and miscellaneous field instruments as shown in the Contract Drawings.
    - b. A wetting supply for interposing relay contacts that provide discrete inputs to the PLC, separately fused for each input group. An additional, separately fused connection, from this supply shall also power the discrete output isolation relay coils.
    - c. A loop power supply for analog inputs, with each analog input separately fused.
- F. Electrical:
1. Main circuit breaker and branch circuit breaker for each branch circuit as required to distribute power from the main power feed.
  2. All breakers accessible when the panel door is open.
  3. No more than 20 devices on any single circuit.
  4. No more than 12 amps for any branch circuit.
  5. Panel (or site) lighting, receptacles, heaters, controls, telemetry and fans on separate branch circuits.
- G. Wiring:

1. Power wiring shall be 300 volt, type THWN stranded copper, No. 14 AWG size, for 120V service.
  2. Discrete wiring shall be 300-volt type THWN stranded copper, sized for the current carried, but not smaller than No. 16 AWG.
  3. Analog signal wiring shall be 300 volt, stranded copper in twisted shield pairs, no smaller than No. 16 AWG.
  4. Panel wiring shall be routed within wire troughs or panduits.
  5. Hinge wiring shall be secured at each end with the bend portion protected by a plastic sleeve.
  6. Analog or dc wiring shall be separated from any ac power or control wiring by at least six inches.
  7. Each wire shall be uniquely identified at all terminations using machine printed plastic sleeves
- H. Construction:
1. Minimum metal thickness: 14-gauge.
  2. Stiffeners as required to prevent deflection under instrument loading and permit lifting without racking or distortion.
  3. When required, removable lifting rings and fill plugs to replace rings after installation.
  4. All components and terminals shall be accessible without removing other components except for covers.
- I. The panel shall be a manufactured item, Hoffman Engineering, or equal.

## 2.05 PANEL DEVICES

- A. All panel devices provided shall be as listed in Orange County Utilities Standards – Appendix D - List of approved products.

## 2.06 PROGRAMMABLE LOGIC CONTROLLER

- A. Monitoring and control of the new equipment shall be accomplished within the PLC. All control strategies specified in Part 3 of this Specification Section shall be implemented within the PLC.
- B. The PLC shall be implemented using Siemens S7 series components. The use of other manufacturer's products will not be acceptable.
- C. The PLC shall comprise the following modules:
  1. Power Supply Module. The power supply module shall convert 120 VAC power into the DC voltages necessary to power the rest of the rack. Siemens model PS 307.

2. Central Processing Unit (CPU) Module. The CPU module shall contain the user program and be equipped with the battery back-up option to protect the program in the event of a power loss. It shall contain dual RS-485 integral ports to communicate with the Operator Interface Terminal and RTU Transceiver. Siemens model S7 315.
  3. Interface Module. The Interface Module shall function as the send (master) connection with the expansion racks. Siemens model IM 360.
  4. Input/Output (I/O) Modules. Provide sufficient I/O modules to accommodate the signals shown on the Contract drawings plus an additional 15% fully wired spares of each type. Use the following modules:
    - a. Analog Input Module. Eight, optically isolated analog input channels. Siemens model S7 331.
    - b. Analog Output Module. Four, isolated analog output channels. Siemens model S7 332.
    - c. Discrete Input Module. Sixteen 120 VAC input channels. Siemens model S7 321.
    - d. Discrete Output Module. Eight 120 VAC, 2A rated relay outputs in two groups of four. Siemens model S7 322.
- D. All PLC input/output modules shall be fully wired to field wiring termination blocks together with all required surge protection, etc.
- E. The Operator Interface Terminal (OIT) shall be a Simatic 22" touch screen. Siemens order number 6AV2 124-0XC02-0AX0.
- F. Mixed Media Ethernet Switch. Provide an Ethernet switch with a minimum of two full duplex 100 Base FX ports and four 100 Base TX ports. Ntron model 106FX2 or approved equal.

## 2.07 SPARES

- A. Provide the following spare parts:
  1. One spare CPU module
  2. One spare Power Supply Module.
  3. One spare I/O module of each type provided.
  4. One spare d.c. power supply of each type provided.
  5. Five percent (rounded up) spare relays of each type provided.
  6. Five percent (rounded up) spare surge suppressors of each type provided.
- B. Provide the following expendables:
  1. Two year supply of corrosion inhibitor capsules
  2. Ten percent (rounded up) spare fuses (minimum of 10) of each type and rating supplied.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Prerequisite Activities and Lead Times: Do not start the following key project activities until the listed prerequisite activities have been completed and lead times have been satisfied:
1. Hardware Purchasing, Fabrication, and Assembly: Associated design related submittals completed (no exceptions, or approved as noted).
  2. Shipment: Completion and approval of all design related submittals.
  3. Startup: Operational Checkout Tests.
  4. OWNER Training: Owner Training Plan completed and O&M manuals delivered.
  5. Demonstration Tests: Operational Check-out Tests, Startup, OWNER Training, and Demonstration Test Procedures must be complete. Give 4 weeks' notice prior to the planned test start date.
- B. Substantial Completion: Substantial Completion for the project is as defined in the General Conditions. However, the following requirements must be fulfilled before consideration will be given for Substantial Completion of the system:
1. All system submittals have been completed.
  2. The system has successfully completed the Demonstration Tests.
  3. The required OWNER training has been completed.
  4. All spares, expendables, and test equipment have been received by OWNER.
- C. Final Acceptance: system final acceptance is defined as the date when the ENGINEER issues a written notice of final acceptance. For this Section, the following must have been completed before consideration will be given to the issuance of notice of final acceptance:
1. All punch-list items have been checked off.
  2. Revisions to the system O&M Manuals have been made (that may have resulted from the Demonstration Tests).

### **3.02 PRODUCT HANDLING**

- A. Adequately pack manufactured material to prevent damage during shipping, handling, storage and erection. Pack all material shipped to the project site in a container properly marked for identification. Use blocks and padding to prevent movement.
- B. Ship materials that must be handled with the aid of mechanical tools in wood-framed crates.



- C. Ship all materials to the project site with at least one layer of plastic wrapping or other approved means to make it weatherproof. Anti-stat protection shall be provided for all sensitive equipment.
- D. Inspect the material prior to removing it from the carrier. Do not unwrap equipment until it is ready to be installed. If any damage is observed, immediately notify the carrier so that a claim can be made. If no such notice is given, the material shall be assumed to be in undamaged condition, and any subsequent damage that is discovered shall be repaired and replaced at no additional expense to the OWNER.
- E. Store and protect equipment until installation following the storage and handling instructions recommended by the equipment manufacturers. Place special emphasis on proper anti-static protection of sensitive equipment.
- F. ESD Protection: Provide for the proper handling, storage, and environmental conditions required for the system components deemed static sensitive by the equipment manufacturer. Utilize anti-stat wrist straps and matting during installation of these items to prevent component degradation.
- G. Protection During Construction: Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the SYSTEM SUPPLIER's recommendations.
- H. Corrosion Protection: Protect all consoles, panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, include capsules in the shipping containers, and equipment as recommended by the capsule manufacturer. During the construction period, periodically replace the capsules in accordance with the capsule manufacturer's recommendations. Replace all capsules just prior to Final Acceptance.
- I. The CONTRACTOR shall be responsible for any damage charges resulting from the handling of the materials.

### 3.03 INSTALLATION

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. Clean and polish the exterior of all panels and enclosures upon the completion of the demonstration tests.
- B. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance.

Coordinate I&C work with the OWNER and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.

### 3.04 TRAINING

- A. The cost of training programs to be conducted with OWNER's personnel shall be included in the Contract price.
- B. All training schedules shall be coordinated with, and at the convenience of the OWNER. Shift training may be required to correspond to the OWNER's working schedule.
- C. Provide a minimum of one day training for up to three of the OWNER's personnel in the maintenance of the hardware which shall include:
  - 1. Training in standard hardware maintenance for the equipment provided.
  - 2. Specific training for the actual hardware configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up.
  - 3. Test, adjustment, and calibration procedures.
  - 4. Troubleshooting and diagnosis.
  - 5. Component removal and replacement.
  - 6. Periodic maintenance.
- D. Provide a minimum of one day training for up to six of the OWNER's personnel in the use of the operator graphic screens.

### 3.05 TESTING - GENERAL

- A. All elements of the system, both hardware and software, shall be tested to demonstrate that the total system satisfies all of the requirements of the Contract Documents
- B. As a minimum, the testing shall include shop tests, operational check-out tests, and Demonstration Tests.
- C. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system producing the correct result (effect), the specific test requirements will have been satisfied.
- D. All tests shall be conducted in accordance with, and documented on, prior approved procedures, forms, and checklists. Each specific test to be performed shall be described and a space provided after it for signoff by the appropriate party after its satisfactory completion. Copies of these signoff test procedures, forms, and checklists will constitute the required test documentation.
- E. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test

with real process variables, equipment, and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.

- F. The SYSTEM SUPPLIER shall coordinate all of their testing with the CONTRACTOR, the ENGINEER, all affected suppliers, and the OWNER.
- G. The ENGINEER reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The ENGINEER's decision shall be final regarding the acceptability and completeness of all testing.

### 3.06 OPERATIONAL READINESS TEST (ORT)

- A. Prior to startup and demonstration testing, certify that the system (inspected, tested and documented) is ready for operation. These inspections and tests shall include Loop/Component inspections and tests. The SYSTEM SUPPLIER shall fully debug problems in the system as a whole. Final approval of control software will not be based on written descriptions of software functions alone, but on actual performance in the field.
- B. Check the entire system for proper installation, calibration and adjustment on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and the Specifications.
- C. The Loop/Component Inspections and Tests shall be implemented using approved forms and checklists. These shall be developed by the SYSTEM SUPPLIER and submitted for approval.
- D. Loop Status Report: Each control loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the SYSTEM SUPPLIER:
  - 1. Project Name
  - 2. Control Loop Number or description
  - 3. Tag Number or description for each component of the control loop
  - 4. Check-offs/sign-offs for each component for proper installation, termination, and calibration/adjustment
  - 5. Check-offs/sign-offs for the control loop for proper panel interface terminations, I/O interface terminations, I/O signal operation relative to the computer network, and total loop operation ready
  - 6. Space for comments
- E. Component Calibration Sheet: Each field instrument element and each PLC I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for signoff by the SYSTEM SUPPLIER:
  - 1. Project Name

2. Component Identification or I/O Module Number
  3. Manufacturer, Model Number/Serial Number of field element
  4. Summary of Functional Requirements (scale, range, computing equation, control action, etc.)
  5. Calibrations of span, setpoints, and preset adjustable parameters
  6. Space for comments
- F. Maintain the Loop Status Reports and Component Calibration Sheets at the jobsite and make them available to the ENGINEER at any time.
- G. Witnessing: These inspections and tests do not require witnessing. However, the ENGINEER will review the Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Check-out Tests. Correct any deficiencies found.

### 3.07 FIELD ACCEPTANCE TEST (FAT)

- A. Once the system has passed the ORT, the SYSTEM SUPPLIER shall perform a witnessed Field Acceptance Test (FAT) on the complete system. The FAT shall demonstrate that the system is operating and in compliance with the Contract requirements. Each specified function shall be demonstrated on a paragraph-by-paragraph, and site-by-site basis.
- B. Prior to the FAT, the entire installed system shall be certified in writing by the CONTRACTOR that it is ready for operation.
- C. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.
- D. The FAT shall cover the entire system, including control functions, alarms, and status monitoring. Test procedures used for shop tests may be adopted for these tests if modified as required.

### 3.08 30-DAY SITE ACCEPTANCE TEST (SAT)

- A. After completion of the Field Acceptance Test, the entire system shall operate for a period of 30 consecutive days, under conditions of full plant process operation, without a single non-field repairable malfunction.
- B. Provide complete O&M Manuals for the system at the jobsite at least two weeks prior to the SAT.
- C. During this test, plant operating and SYSTEM SUPPLIER personnel shall be present as required. The SYSTEM SUPPLIER is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system.
- D. While this test is proceeding, the OWNER shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.

- E. Any malfunction during the tests shall be analyzed and corrections made by the SYSTEM SUPPLIER. The ENGINEER and/or OWNER will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
- F. Any malfunction, during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence by the SYSTEM SUPPLIER's personnel, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.
- G. Upon completion of repairs, by the SYSTEM SUPPLIER, the test shall be repeated as specified herein.
- H. In the event of rejection of any part or function, the SYSTEM SUPPLIER shall perform repairs or replacement within 90 days.
- I. All data base errors must be corrected prior to the start of each test period. The 30-day test will not be considered successful until all databases are correct.
- J. The total availability of the system shall be greater than 99.5 percent during this test period.
  - 1. Availability is given by  $1 - (\text{Total Time-Down Time} / \text{Total Time})$ .
  - 2. Down times due to power outages or other factors outside the normal protection devices or back-up power supplies provided, shall not contribute to the availability test times above.
- K. Upon successful completion of the 30-day Site Acceptance Test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the warranty period shall commence.

### 3.09 CONTROL STRATEGIES

- A. General. Provide control strategies that meet the following general conditions:
  - 1. Wherever in the descriptions the control strategy refers to the operator, it is intended to mean via the operator graphic screens on the OIT or at the SCADA master site.
  - 2. All control strategies shall run within the PLC. Data manipulation (calculated analog values, elapsed time functions, event determination) shall be performed by the PLC for the associated equipment it is monitoring. Any resulting values from these manipulations shall be reported as individual registers. The intent is to avoid utilizing the HMI software for this purpose.
  - 3. The control functions described herein are not intended to be complete comprehensive programming logic descriptions. They describe only the general intended control operation required. Provide complete program logic to completely fulfill the functional requirements indicated.
  - 4. Provide all programming necessary to support the functional requirements of the operator graphic screens.

5. Provide complete debugging services to address issues identified by the OWNER or ENGINEER during and after startup until final acceptance.
- B. Provide an operator controllable feed pump assignment matrix as shown in Table 13300-1 below. For the Pre-CCC Phase I/II feed point, allow the operator to assign two pumps. For all other feed points, allow only one feed pump to be assigned. Each pump shall only be assignable to one feed point.

<b>Feed Point</b>	<b>Assignable Pumps</b>
Pre-CCC Phase I/II	1A, 2A, 3A
Pre-Filter Phase I/II	3A, 2B
Pre-CCC No. 3 Phase III	1B, 2B
Pre-Floc Chamber Phase III	2B, 3B
Pre-CCC No. 4 Phase III	3B, 4B
Pre-Filter Phase V	1C, 2C
Pre-CCC Phase V	2C, 3C

**Table 13300-1: Pump Assignment Matrix**

- C. Whenever a feed pump assignment is changed, de-assign and temporarily suspend the control signals to the originally assigned pump. Indicate in color on the graphic screen the required valve positions and provide a pop-up CONTINUE pushbutton and a notice to the operator to modify the valves accordingly. After the operator has made the changes, the CONTINUE pushbutton will be pressed. At that point, automatically start the pump(s) assigned to pre-CCC feed points and restart the control strategy by transmitting the signals to the newly assigned pump. For pumps assigned to pre-filter/floc feed points, await the START command from the individual pump strategy before starting the newly assigned pump.
- D. Pre-CCC Feed Point Pumps. Provide an operator controllable FLOW/COMPOUND software select switch and proceed as follows:
1. While the switch is in FLOW, adjust the pump speed to an operator adjustable ratio of the appropriate flow signal as listed in Table 13300-2 below.
  2. While the switch is in COMPOUND, trim the feed pump flow ratio to maintain an operator adjustable set-point for a future analyzer. These analyzers will be installed by others under a future contract. That work will include tuning of the compound loop. However, the SYSTEM SUPPLIER shall provide the control strategy with the capability such that the future contract will only have to modify the tuning based on the type and location of the analyzer.
- E. Pre-Filter/Floc Feed Point Pumps. Provide an operator controllable MANUAL/FLOW software select switch and proceed as follows:

1. While the switch is in MANUAL, use the individual feed pump control strategy described below.
  2. While the switch is in FLOW, adjust the pump speed to an operator adjustable ratio of the appropriate flow signal as listed in Table 13300-2 below.
- F. Individual Feed Pump Control. Provide operator controllable software MANUAL/AUTO select switch, START and STOP pushbuttons and SPEED potentiometer. Proceed as follows:
1. While the switch is in MANUAL, start and stop the pump based on the START and STOP pushbuttons and run the pump at the speed set by the potentiometer.
  2. While the switch is OFF, stop the pump and prevent any control signals. Also disable the pump from the pump assignment matrix described above.
  3. While the switch is in AUTO, start and stop the pump and run it at the speed set by the above feed point strategies.

<b>Feed Point</b>	<b>Flow Pace Source</b>
Phase I/II	Summed CCC 1 and 2 Effluent Flows
Phase III	CCC-3 Effluent Flow
Phase IV	CCC-4 Effluent Flow
Phase V	CCC-5 Effluent Flow

**Table 13300-2: Feed Pump Flow Pacing Source**

**END OF SECTION**

**SECTION 13591  
NETWORK CABLE**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. The Network Cable section covers the furnishing and installation of cable systems to provide communications for the Network System as indicated on the drawings.
- B. Accessories and appurtenances shall be provided as specified herein to provide a complete and properly operating system.
- C. Equipment and services provided under this section shall be subject to the requirements specified in the Process Instrumentation and Control System Section and the Ethernet Networks section. Supplementing the Network Cable section, network data, special requirements, and options are indicated on the drawings.

1.02 SUBMITTALS

- A. Submittals shall be made as specified in the Process Instrumentation and Control System section.
  - 1. Qualifications: The name, address and telephone number of the proposed contractor or subcontractor, including specific personnel to perform the work shall be included with the submittals. Provide the experience record of the subcontractor and personnel in performing work similar to that specified. Include the agency, contact person, and telephone number of at least three (3) previous network installation projects completed by the proposed subcontractor. The Engineer shall review and approve the network installation subcontractor and personnel prior to any of the related work being performed. This review will be conducted during the project submittal phase, as described below.
  - 2. Drawings and Data: All material and equipment documentation shall be submitted for review in accordance with the Submittals section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment. Product data shall include the following in the Submittals section:
    - a. Cut sheets and catalog literature for proposed fiber optic cable, and fiber optic cable accessories (pigtails, connectors, etc.)
    - b. Manufacturer specifications and data that clearly shows that the fiber optic cable meets all requirements as specified herein.
    - c. Sample of the proposed cable.
    - d. Physical dimension drawings of all fiber optic accessories.
    - e. Proposed fiber identification sequence and labeling.



- f. Provide off-line maintenance aids and on-line diagnostics to check the performance of the communication links and interfaces of devices on the data highway.
  - g. Provide a Recommended Spare Parts List (RSPL).
  - h. Provide a list of recommended special tools for fiber installation testing or maintenance.
3. Operations and Maintenance Manuals: Operation and Maintenance Manuals shall have the following items included in addition to those items specified in other sections:
- a. Description of all components.
  - b. Methods of connection.
  - c. Connection diagram.
  - d. OTDR trace plots for all fibers.

#### 1.03 SHIPMENT, PROTECTION, AND STORAGE

- A. Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of the Process Instrumentation and Control System section.

#### 1.04 QUALIFICATIONS

- A. Due to the specialized nature of installing, splicing, terminating, and testing optical fiber cable, the Contractor shall utilize personnel who are experienced in such practices. The installing Contractor or Subcontractor shall have performed similar installation and testing work on at least three projects of similar size and complexity. The personnel assigned to the installation and testing shall also have experience on at least three projects of similar size and complexity.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL

- A. All fiber optic cable, fiber optic hardware and accessories shall be designed, assembled and connected in accordance with the requirements of these specifications and the drawings.

#### 2.02 ETHERNET UNSHIELDED TWISTED PAIR (UTP) CABLE

- A. Ethernet cables and connectors shall be provided for a complete and working system, and/or as shown on the drawings. Cable for Ethernet wiring shall be UTP Cat-6 cable. Cable shall be Cat-5e for network speeds up to 100 MHz, and Cat-6 for network speeds greater than 100 MHz. Jacket color coding for cables shall be as follows:
  - 1. Standard Cat-6. Yellow
  - 2. Crossover cables. Red
- B. Cable shall meet the following characteristics:
  - 1. Category 6 UTP Cable. Cat-6 cable shall meet the following requirements:

- a. 24 AWG
  - b. 4 pair solid strand FEP Teflon insulation
  - c. 100 Ohm impedance
  - d. 1-250 MHz frequency range
  - e. Min attenuation 19.9 Db
  - f. 100 Ohm impedance
  - g. Min NEXT 44.3dB/100MHz
  - h. Min PS-NEXT 42.3dB/100MHz
  - i. Min ELFEXT 27.8dB/100MHz
  - j. Min PS-ELFEXT 24.8dB/100MHz
  - k. Min return loss 20.1 dB/100 MHz
  - l. Max delay skew 45 ns
  - m. Max propagation delay 540 ns
2. Plenum rated cable shall have FEP insulation jacketing and FEP insulation for conductors. Non plenum rated cable shall have PVC insulation jacketing and polyethylene insulation for conductors.
  3. Cat-6 cable shall be Belden 1872 or equal.
  4. Ethernet Patch Cables. Pre-wired and terminated patch cables with RJ-45 connectors and lever protecting boot shall be furnished for all connections to computers, network equipment, and controller equipment except where physical conditions (i.e. length over 12 ft. or conduit size) require unterminated wire to be installed. Patch cables shall be Cat-6 and shall meet the requirements of Cat-6 cable specified in this section. Straight through cables shall be wired using the T568-B standard for both connectors as shown in section 3.01, A, 1. Crossover cables shall be wired using the T568-A standard for one connector and the T568-B standard for the opposite end.

### 2.03 FIBER OPTIC CABLE

- A. The fiber optic cable must meet all of the requirements of the following paragraphs.
  1. The fiber optic cable must meet the requirements of the National Electrical Code (NEC) Section 770.
  2. Riser Applications – Applicable Flame Test UL 1666.
  3. Finished cables shall conform to the applicable performance requirements of Table 8-6 and 8-7 in the Insulated Cable Engineers Association, Inc. (ICEA) Standard for Fiber Optic Premises Distribution Cable (ICEA S-83-596).
  4. Every fiber in the cable must be usable and meet required specifications.
  5. All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.
  6. Each optical fiber shall consist of a doped silica core surrounded by a concentric glass cladding. The fiber shall be a matched clad design.
  7. All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 kpsi.

8. All optical fibers shall be 100 percent attenuation tested. The attenuation shall be measured at 850 nm, and 1300 nm for multimode fibers. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers. The manufacturer shall store these values for a minimum of 5 years. These values shall be available upon request.
9. The storage temperature range for the cable on the original shipping reel shall be  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ . The operating temperature range shall be  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ . Testing shall be in accordance with FOTP-3.
10. The attenuation specification shall be a maximum attenuation for each fiber at  $23 + 5^{\circ}\text{C}$ .
11. The attenuation of the cabled fiber shall be uniformly distributed throughout its length such that there are no discontinuities greater than 0.2 dB at 850 nm/1300 nm (multimode) in any one kilometer length of fiber.
12. Required Fiber Grade: Maximum Fiber Attenuation at 850 nm shall be 3.5dB/km.
13. Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 mm.
14. The cable shall contain 24 fibers. Each buffer tube shall contain up to 12 fibers.
15. The fibers shall not adhere to the inside of the buffer tube.
16. Each fiber shall be distinguishable from others by means of color coding in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."
17. The fibers shall be colored with ultraviolet (UV) curable inks.
18. Buffer tubes containing fibers shall also be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."
19. In buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other. Colors shall not cause fibers to stick together.
20. The buffer tubes shall be resistant to kinking.
21. The cable jacket color shall be black.
22. Fibers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fibers shall be placed so that they do not interrupt the consecutive positions of the buffer tubes. In dual layer cables, any fillers shall be placed in the inner layer. Fillers shall be nominally 3.0 mm in outer diameter.
23. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as consistent with the best commercial practice. The jacket shall provide the

cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.

24. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet (e.g. "62.5/125 MICRON – TYPE OFNR – (UL) 00001 Feet"). The print color shall be white.
  25. The cable shall be all-dielectric.
  26. The cable shall be gel-free.
  27. The outside diameter of the cable shall not exceed 7 mm.
  28. Flammability – All cables shall comply with the requirements of the 1996 NEC Article 770. All cables shall pass UL 1666.
  29. Fiber optic cable shall be as manufactured by Corning Cable Systems, Belden, BICCGeneral, AMP or equal.
- B. Multimode Fiber. Multimode fiber shall be 62.5/125µm core diameter cable.
1. 62.5 µm core diameter multimode fiber optic cable shall meet the following requirements:
    - a. The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492AAAA-1989, "Detail Specification for 62.5 µm Core Diameter/125 µm Cladding Diameter Class Ia Multimode, Graded Index Optical Waveguide Fibers."
    - b. Core diameter:  $62.5 \pm 3.0$  micrometers.
    - c. Cladding diameter:  $125.0 \pm 2.0$  micrometers.
    - d. Core-to-Cladding Offset:  $\leq 3.0$  micrometers.
    - e. Cladding non-circularity:  $\leq 2.0\%$ . Defined as:  $[1-(\text{min. cladding dia.} + \text{max. cladding dia.})] \times 100$ .
    - f. Core non-circularity:  $\leq 6.0\%$ . Defined as:  $[1-(\text{min. core dia.} + \text{max. core dia.})] \times 100$ .
    - g. Coating Diameter:  $245 \pm 10$  micrometers.
    - h. Graded index.
    - i. Numerical Aperture:  $0.275 \pm 0.015$ .
    - j. Attenuation Uniformity: There shall be no point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.
    - k. Minimum Bandwidth Requirement shall be 160/500 MHz-km at 850/1300 nm.
- C. Singlemode Fiber. Not used.
- D. Fiber optic cable connectors. All optical fibers shall be terminated with connectors that are type ST for multimode cable.
1. Epoxy Connectors: Epoxy connectors shall be provided to terminate each fiber in the cable. Connector style, ST shall be coordinated with the patch panels and field devices that will interface directly with the cable. Connectors shall be compatible with the supplied cable. Connector loss shall be no greater than 0.3 dB. Loss measurement shall be performed at the time of splicing and

documentation shall be furnished for each termination. Connectors shall be Corning Cable Systems Connectors, or equal.

2. Crimp Style Connectors. Not used.
- E. Fiber Optic Jumper Cables: Fiber optic jumper cables shall be furnished and installed for equipment interfacing and between termination cabinets. The jumpers shall meet the following requirements:
1. The jumpers shall be 62.5/ 125 microns, multimode for operation at 1300 nm. They shall be tight-buffered and be protected by Kevlar-type strength material.
  2. The jumpers shall be supplied with connectors on each end. Connector type ST shall be matched to the equipment provided. Jumpers shall be sized to provide a single connection between the fiber optic hardware being connected.

#### 2.04 FIBER OPTIC PATCH PANEL

- A. Fiber optic patch panel shall provide a single location for splicing, terminating, patching and testing fiber optic cables entering communication and control panels. Fiber patch panel shall have a protective housing for breakout of individual fibers and for splices. The splice area shall support fusion splices for 50  $\mu$ m multimode optical fiber and shall provide strain relief for individual fibers. A slide-up or swing-open front door shall be provided.
- B. The patch panel shall meet the following requirements:
1. The patch panel shall be sufficiently sized to accommodate the full number of strands in each cable to be terminated plus 50% spare capacity.
  2. Each fiber strand in each multimode cable shall be terminated so that all strands of all cables are made available at bulkhead-mounted SC connectors that are mounted on patch panels.
  3. Front and rear tilt-up lids shall provide unobstructed access to adapters and mounting plates.
  4. The panel shall provide for patch cord and splice tray storage in the same unit.
  5. The panel shall provide horizontal side cable entry ports.
  6. The connector shall provide a strain relief mechanism for installation on a fiber cable that contains strength elements. The fiber within the body of the connector shall be isolated mechanically from cable tension, bending and twisting.
  7. A directory shall be provided at the fiber optic patch panel logically identifying each optical fiber within.
  8. Dust caps shall be furnished and installed on all unused patch panel connectors.
- C. Fiber Optic Patch Panel shall be OFS Technologies "Fiber Interconnect Unit", Corning Cable Systems WCH series, or equal.

- D. Fiber Optic Patch Panel shall be installed in an enclosure, NEMA rated for the environment in which it is to be installed. The enclosure shall be equipped to allow locking with a pad lock.

2.05 ETHERNET CABLE TEST EQUIPMENT

- A. One hand-held network cable tester that is compatible with the provided network cabling shall be provided. The cable tester shall check for open pairs, shorted pairs, crossed pairs, reversed pairs and split pairs for faults up to 100 m. Tester shall be Black Box “Model Localmap 100 TS620A”, Fluke MicroScanner2 Pro, or equal.

**PART 3 - EXECUTION**

3.01 INSTALLATION

- A. The System Supplier shall be responsible for the coordination of the installation of all cable furnished hereunder. The System Supplier shall be responsible for the termination of all cable furnished hereunder.
  1. Cable Damage: If the cable becomes damaged during installation, the Contractor shall stop work and notify the Engineer immediately. The Owner and Engineer will decide whether to replace the entire reel of cable or to install a splice at the damaged section. If the Owner decides to replace the entire reel of cable, the Contractor shall begin the installation at the last designated splice point. The damaged cable between these points shall be removed, coiled, tagged, and given to the Owner. Installation of new cable to replace damaged cable shall not be a basis of extra payment or contract completion time. In addition to installation of the new cable, the Contractor shall reimburse the Owner for the entire cost of the replacement reel of cable. This cost will be withheld from the contract price. If the Owner decides to install a splice at the damaged point, and the cable is damaged a second time, the entire reel of damaged cable (and all subsequent damaged reels) shall be replaced with new reels at the Contractor’s expense.
  2. Ethernet Cable Installation: Straight through cables shall be wired using the T568-B standard for both connectors as shown in the table below (connector pin numbers are left to right with the clip down). Crossover cables shall be wired using the T568-A standard for one connector and the T568B standard for the opposite end as shown in the table below.

Connector Pin	568A Wiring Conductor	568B Wiring Conductor
1	White/Green	White/Orange
2	Green	Orange
3	White/Orange	White/Green
6	Orange	Green
4	Blue	Blue
5	White/Blue	White/Blue

7	White/Brown	White/Brown
8	Brown	Brown

3. Fiber Optic Cable Installation: The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification. Fiber optic cable installation shall meet the following requirements:
  - a. All fiber optic cable shall be installed, terminated, and tested by the System Supplier or his fiber subcontractor as specified above.
  - b. In pulling the cable, strain-release, or other tension limiting devices shall be used to limit the pull tension to less than 600 lbs.
  - c. Minimum bend radius restrictions shall be satisfied both during and after cable installation.
  - d. Horizontal, unsupported cable runs shall be supported at continuous distances of 5 feet or less.
  - e. All conduit and cabinet entrances shall be sealed with RTV or other reenterable sealant material to prevent ingress of water, dust or other foreign materials.
  - f. Cable routing within occupied office areas shall conform to Federal, State, and local electrical and fire codes.
  - g. Any non-terminating (field) splices shall be documented as to the physical location and cable meter mark (prior to stripping). Field splices shall be OTDR-tested and documented prior to final cable acceptance testing.
  - h. Fiber optic cables shall be installed in accordance with NECA 301-2004, Installing And Testing Fiber Optic Cables.

### 3.02 CABLE TESTING

- A. After the network cabling has been installed, each network cable shall be tested.
  1. Test Equipment: Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by System Supplier for the duration of the testing work and this test equipment will remain the property of System Supplier.
  2. Ethernet UTP Cable Testing: The System Supplier shall utilize the previously specified test equipment, and additional tools as needed to validate the Ethernet UTP cable installation. All test equipment shall bear current calibration certification from a certified calibration laboratory, as appropriate. Each cable shall be tested for open pairs, shorted pairs, crossed pairs, reversed pairs and split pairs. A check off sheet shall be utilized, shall be signed by the technician testing the cables, and shall be submitted for approval. Any identified faults shall be corrected at no additional cost.
  3. Fiber Optic Cable Testing: Acceptance testing of the data highway (fiber and electronic equipment) shall be conducted as a part of integrated system field

testing, as specified elsewhere. Prior to such tests, however, the fiber optic cable shall be tested as specified herein.

- a. The System Supplier, or his fiber subcontractor, shall conduct fiber optic cable testing as specified below. All testing following field installation shall be witnessed by the Engineer. A test plan shall be submitted prior to the proposed test dates. The test plan and procedures shall be mutually agreed to prior to conducting the tests.
- b. Each optical fiber of each fiber optic cable shall be OTDR (Optical Time Domain Reflectometer) tested on the reel at the factory, on the reel upon arrival at the jobsite, and after installation and termination. For each fiber, an OTDR (Optical Time Domain Reflectometer) trace soft/hardcopy is required to be provided to the Owner and Engineer. OTDR traces shall be provided for each test (at the factory, on the reel at the job-site, and after installation). A 100 foot launch cable shall be spliced to each fiber for each fiber OTDR test, to ensure accurate results. This end-to-end trace shall be performed from BOTH ends of the fiber. Also for each fiber, an end-to-end power attenuation (insertion loss) test shall be performed. The attenuation test shall use a stabilized optical source and an optical power meter calibrated to the appropriate operating wavelength (1300 nm).
- c. For each installed fiber, the power attenuation shall not exceed the following, tested from connector to connector at the respective patch panels:

$$(0.0035)L + (0.25)N + 3.0 \text{ dB}$$

Where L = the length of the fiber optic cable in meters and  
N = the number of splices in the fiber.

- d. Any fiber optic cables containing one or more fibers not meeting this performance will not be accepted by the Owner, and shall be repaired or replaced at no additional cost.
- e. Each fiber optic jumper cable shall be tested and must exhibit an end-to-end attenuation of less than 2.0 dB at 1300 nm. Any jumper exceeding this level shall be replaced at no additional cost to the owner. Any damaged cable still on the reel shall be returned to the manufacturer for replacement at no additional cost to the Owner.
- f. All fiber cable testing shall be documented on pre-approved test forms. Three (3) copies of all documentation (including OTDR traces) shall be submitted to the Engineer upon successful completion of the testing.

## END OF SECTION



**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 15000**  
**GENERAL MECHANICAL REQUIREMENTS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Furnish all labor, materials, services, supplies, tools, equipment, transportation and facilities necessary to install complete and operable all mechanical equipment as shown on the Drawings and specified in this Division.
- B. Drawings and Specifications: The Drawings and Specifications shall be considered as complementary, one to the other, so that materials and work indicated, called for, or implied by the one and not by the other shall be supplied and installed as though specifically called for by both. The Drawings are to be considered diagrammatic, not necessarily shown in the detail or to scale all of the equipment or minor items. In the event of discrepancies between the Drawings and the Specifications, or between either of these and any regulations or ordinances governing work of this Division, the Bidder shall notify the Engineer in ample time to permit revisions.
- C. Safety Requirements: In addition to the components specified and shown on the Drawings and necessary for the specified performance, the Contractor shall incorporate in the design and show on the shop drawings all the safety features required by the current codes and regulations, including, but not limiting to, those of the Occupational Safety and Health Act of 1970, and Amendments thereto.

1.02 QUALITY ASSURANCE

- A. All equipment and materials used in this installation shall be new, of the best quality and unless otherwise noted, shall be standard catalog items of the various manufacturers.
- B. Equipment and appurtenances shall be designed in conformity with ANSI (formerly ASA), ASME, IEEE, NEMA, OSHA, AGMA, and other generally acceptable applicable standards. They shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions or operations. All bearings and moving parts shall be adequately protected against wear by bushings or other approved means. Provisions shall be made for adequate lubrication with readily accessible devices.
- C. Machinery parts shall conform to the dimensions shown on the working drawings within allowable tolerances. The corresponding parts of identical machines shall be made interchangeable. Protruding members such as joints, corners and gear covers

shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

D. Clearances and Access: Ample clearance shall be provided for inspection and adjustment. All equipment shall fit the allotted space and shall leave reasonable access room for servicing and repairs. Greater space and room required by substituted equipment shall be provided by the Contractor and at his expense. Provide access panels at walls or ceilings for access to valves, dampers, equipment or any part requiring maintenance or service. Provide minimum sizes of 12 inches by 12 inches for hand access or 24 inches by 24 inches for personnel access.

E. Safety Requirement:

1. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI, OSHA, and local industrial codes.
2. The Contractor shall provide for each V-belt drive or rotating shaft a protective guard which shall be securely bolted to the floor or apparatus. The guard shall completely enclose drives and pulleys and be constructed to comply with all safety requirements.
3. For fans, the belt guard shall be arranged so as not to restrict the air flow into the fan inlet. Guards shall not interfere with lubrication of equipment.

#### 1.03 PROTECTIVE COATINGS

- A. All machined surfaces and shafting shall be cleaned and protected from corrosion by the proper type and amount of coating necessary to assure protection during shipment and prior to installation.
- B. Oil lubricated gearing, bearings, etc. are to be shipped with an oil soluble protective coating as recommended by the equipment manufacturer.
- C. Motors, reducers and electric controls shall have the standard factory finish prior to delivery.
- D. Refer to Section 09900 for painting.

#### 1.04 PREPARATION FOR SHIPMENT

- A. Fabricated sub-assemblies, if any, shall be shipped in convenient sections as permitted by carrier regulations and shall be properly match-marked for ease of field erection.

#### 1.05 INSTALLATION OF EQUIPMENT

- A. Precision gauges and levels shall be used in setting all equipment. All piping and equipment shall be perfectly aligned, horizontally and vertically. Tolerances for piping and equipment installation shall be 1/2- inch in 30 ft. horizontal and vertically.

All valves and operators shall be installed in the position shown on the plans or as directed by the Engineer if not shown.

- B. The Contractor shall have on site sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled when practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations and supports at the locations and elevations shown on the Drawings, unless otherwise directed by the Engineer during installation.
- D. The equipment shall be brought to proper level by shims (1/4-inch maximum). After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bind the machine firmly into place against the wedges or shims. Grout shall be as specified in Division 3.
- E. The grout shall be tamped into position with a board, steel bar or other tool. Tamping should not be so hard as to raise or otherwise displace the plate.
- F. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.
- G. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the equipment manufacturer's qualified mechanic, millwright, machinist, or authorized representative, to align the pump and motor prior to making piping connections or anchoring the pump base.
- H. All rotating equipment shall be statically and dynamically balanced. Unless otherwise specified, the vibration allowance in the units shall not exceed the upper limits as established by the manufacturer.
- I. Equipment of a portable nature which requires no installation shall be delivered to a location designated by the Owner.
- J. All cutting and patching necessary for the work shall be performed by the Contractor. Where interferences occur, and departures from indicated arrangements are required, the Contractor shall coordinate the mechanical work with the other trades involved and make a determination as to changed locations and elevations of ductwork and/or piping and shall obtain approval from the Engineer for the proposed changes.
- K. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be coated, according to Section 09900.

## 1.06 EQUIPMENT FOUNDATION AND SUPPORTS

- A. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by the Contractor.
- B. All floor mounted equipment shall be mounted on a reinforced concrete pad of four inches in height as a minimum or as required by the Drawings.
- C. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. These shall be of ample size and strength for the purpose intended.
- D. Anchor bolts required or indicated by the Drawings shall be furnished and built into the concrete foundations.
- E. Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division shall be provided and installed by Contractor.
- F. All foundations, anchor pads, piers, pipe supports, and structural steel supports shall be built to template and reinforced as required for loads imposed on them.
- G. The Contractor shall assume all responsibility for sizes, locations and design of all foundations, anchor pads, piers, pipe supports, curbs and structural steel supports.

## 1.07 VIBRATION ISOLATION

- A. All rotating or reciprocating equipment unless otherwise directed shall be mounted on vibration isolators and provided with flexible connections to isolate the equipment from the structure and/or installation.
- B. Isolators shall produce uniform loading and deflections, regardless of equipment weight distribution, and shall be the product of a manufacturer regularly engaged in the production of such items and who publishes engineering and selection data.

## 1.08 LUBRICATION

- A. The Contractor shall thoroughly lubricate all equipment in accordance with the equipment manufacturer's instructions. Lubricating oils and greases shall be of type and viscosity as recommended by the equipment manufacturer.
- B. All lubricants shall be furnished by the Contractor.
- C. All systems requiring oil lubrication for gearing, bearings, etc., are to be flushed with flushing oils as recommended by the equipment manufacturer. This includes all gearings, bearings, etc., regardless of whether they have been shipped with or without oil soluble protective coatings.

- D. Following flushing, oil lubricated systems shall be filled with "run-in" oil as recommended by the equipment manufacturer. The equipment will be "run-in" at the no-load condition for a minimum period of 2 hours. Following "run-in" and inspection, the equipment is to be drained and flushed again with flushing oil as recommended by the equipment manufacturer.
- E. The schedule for the above procedures is to be submitted for review by the Engineer at least two (2) weeks prior to the selected procedure starting date. At this time inspection details can be worked out.
- F. The Contractor shall provide a one-year supply of all types of lubricants required for the various types of equipment furnished and installed under this Contract. Lubricants shall be in metal containers suitably labeled.

#### 1.09 TEST OPERATION

- A. When equipment is required to be factory tested, the results of the tests shall be submitted to the Engineer and approval of the test results shall be obtained before shipment of the equipment.
- B. When an item of equipment, including controls and instrumentation, has been completely erected, the Contractor shall notify the Engineer, who will designate a time to make such tests as required, and operate the item to the satisfaction of the Engineer. All testing shall be done in the presence of the Engineer. "Completely erected" shall mean that the installation is erected, all necessary adjustments have been made, all required utility connections have been made, required lubricants and hydraulic fluid have been added and the unit has been cleaned up.
- C. Contractor shall furnish labor, lubricants, and all other materials, equipment and instruments necessary for all tests.

#### 1.10 FAILURE OF TESTS

- A. Any defects in the equipment, or deviations from the guarantees or requirements of the Specifications, shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails to correct any defects or deviations, or if the replaced equipment when tested shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for such equipment, may reject that equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- B. In case the Owner rejects a particular item of equipment, then the Contractor hereby agrees to repay the Owner all sums of money paid to him and the Owner agrees to deliver to the Contractor a bill of sale of all his rights, title, and interest in and to the

rejected equipment provided, however, that the equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected. The bill of sale shall not abrogate the Owner's right to recover damages for delays, losses or other conditions arising out of the basic Contract. The Owner hereby agrees to obtain the alternate equipment within a reasonable time and the Contractor agrees that the Owner may use the original equipment furnished by him without rental or other charge until the other equipment is obtained.

#### 1.11 RESPONSIBILITY DURING TESTS

- A. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

#### 1.12 EQUIPMENT MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Equipment which will require any manufacturer's service representative for the purpose of assisting and directing and installation and adjustment of equipment is noted in the applicable sections of this Division. All costs relative to services by equipment manufacturer's service representatives shall be borne by the Contractor.
- B. A letter of certification (check-out memo) shall be submitted to the Engineer from the manufacturer's representative upon completion of project visit indicating that the equipment has been checked out and is in proper working order and that the project personnel have been instructed in the proper use of the equipment.

#### 1.13 NAMEPLATES

- A. Provide identification nameplates for all equipment, controls, and apparatus where nameplates and/or data plates are not specified elsewhere.
  - 1. Equipment and apparatus nameplates shall be fabricated from 1 1/2-inch high black laminated plastic with 1 inch high cut-in white letters, permanently secured with stainless steel screws.
  - 2. Controls and switches shall be labeled with 1 inch high black laminated plastic with 1/2-inch white letters to designate functions.
  - 3. Nameplates schedule and sample shall be submitted to the Engineer for approval.
- B. Each piece of equipment shall be provided with stainless steel data plate securely fastened in a conspicuous place and clearly inscribed with the equipment manufacturer's name, year of manufacture, serial number and principal rating data. These data plates shall not be painted.

#### 1.14 PIPE AND VALVE IDENTIFICATION

##### A. Pipe Identification:

1. All exposed pipe shall have code letters and flow arrows painted as per specification Section 09905. The mechanical contractor shall ensure that the pipes are properly marked.
2. All underground pipe shall be located by laying plastic warning tape continuously along the run of pipe as per specification Section 09905.

##### B. Valve identification: On all valves, the Contractor shall provide a coded and numbered identification tag as per specification Section 09905.

#### 1.15 EQUIPMENT CLEANING

##### A. All equipment, piping, duct work, insulation and other work provided under this Division and to receive finish painting by the General Contractor shall be thoroughly cleaned and ready for finish painting.

##### B. Thoroughly inspect all items of equipment and any items dented, scratched or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and approval.

#### 1.16 SYSTEM CLEANING

##### A. Each system of piping shall be blown through, washed out and/or flushed after completion to remove grit, dirt, sand, etc., from coils and piping for as long a time as required to thoroughly clean the apparatus.

##### B. All elements within the system that may be damaged by the cleaning operation shall be removed or otherwise protected during the operation.

##### C. Repair or replace any control valves or other system components which do not function properly due to damage during the cleaning operation or because of imperfect cleaning of any piping system.

##### D. All strainers shall be inspected and cleaned as often as required and left in a clean condition at project completion.

#### 1.17 PRESSURE TESTS

##### A. After installation, all piping shall be pressure tested. Piping shall be tested in accordance with Section 15044.



- B. All tests shall be made in the presence of and to the satisfaction of the Owner's representative and also, to the satisfaction of any local or state inspector having jurisdiction.
  - 1. Provide not less than three days notice to the Engineer and the authority having jurisdiction when it is proposed to make the tests.
  - 2. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Engineer shall be retested in part or in whole as directed by the Engineer.
  - 3. The piping systems may be tested in sections as the work progresses but no joint or portion of the system shall be left untested.
- C. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
- D. All defects and leaks observed during the tests shall be corrected and made tight in an approved manner and the tests repeated until the system is proven tight.
- E. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.
- F. Provide test pumps, gauges, and other instruments and equipment required for the performance of all tests. Provide all temporary bracing, test plugs, and additional restraint which may be required for test pressures above normal working pressures.
- G. All tests shall be maintained for as long a time as required to detect all defects and leaks but not less than the duration specified for each type of pipe or piping system in this Division.

#### 1.18 PROTECTION OF PIPING, DUCT WORK AND APPURTENANCES

- A. All duct work, piping, appurtenances, and openings furnished and installed under this Division shall be protected from dirt, foreign objects, and damage during the construction period. Damaged piping, duct work or other appurtenances shall be replaced without additional cost to the Owner, should the damage occur prior to final acceptance of the work by the Owner. As soon as installed, all metal plated or polished fixture trimmings shall be thoroughly covered with noncorrosive grease which shall be maintained until all construction work is completed.
- B. Suitable precautions against freezing shall be taken during cold weather.
- C. All open ends of piping shall be closed by suitable cap or plug fitting to prevent obstruction and damage.
- D. The Contractor shall also be responsible for the work of other trades that may be damaged or disturbed in the course of this work and he shall restore it to the condition existing prior to damage without additional cost to the Owner.

1.19 FIRE HAZARD RATING

- A. All piping, duct work, and equipment insulation, fastener, and jacketing materials shall have a fire hazard rating not to exceed 25 for flame spread, 50 for fuel contributed, and 50 for smoke developed. Rating shall be determined by ASTM Designation E84, "Surface Burning Characteristics of Building Materials". Corresponding ratings determined by Underwriters' Laboratories, Inc., UL-723, "Test Method for Fire Hazard Classification of Building Materials", will also be acceptable.
- B. Fire hazard ratings for materials proposed for use shall be substantiated by test results from the National Bureau of Standards, a certified report from an approved testing laboratory, or a UL label or listing.
- C. Flameproofing treatments will not be accepted.

**PART 2 - PRODUCTS**

2.01 PIPE MATERIALS SCHEDULE:

<u>SERVICE</u>	<u>ABBREVIATION</u>	<u>ALLOWABLE MATERIALS</u>
Potable Water, Pressure and Gravity Pipe, Buried, ≥4"	PW	DIP
Potable Water, Pressure <4"	PW	PVC, Brass
Sodium Hypochlorite	SH	PVC
Vent Pipe	V	STL, PVC

2.02 PIPE MATERIAL ABBREVIATIONS

<u>ABBREVIATION</u>	<u>DESCRIPTION</u>	<u>SPEC. SECTION</u>
DIP	Ductile Iron Pipe, Cement Lined, unless otherwise noted	15062
PVC	Polyvinyl Chloride, SCH 80, unless otherwise noted	15070

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 15044**  
**PRESSURE TESTING OF PIPING**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Furnish all labor, materials, and equipment required for the pressure testing of chemical solution, and all other equipment per these specifications.
- B. Related Work Described Elsewhere

1.02 TEST PRESSURES

- A. Test pressures for the various services and types of piping are shown at the end of this section in Table 15044.

1.03 SUBMITTALS

- A. Test Report
  - 1. The Contractor shall submit a test report which includes the following information:
    - a. Date and time of tests.
    - b. Name(s) of person(s) conducting tests and company name.
    - c. Test locations.
    - d. All pressure gauge locations and pressures at time of tests.
    - e. Allowable leakage for test sections per Specifications.
    - f. Actual leakage during tests with the time and pressure at the end of the test.
  - 2. Submit five (5) copies and one (1) original copy of the test reports to the Engineer upon completion of the testing.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### 3.01 GENERAL

- A. Hydrostatic testing of solution lines shall be performed using potable water at 150 PSI for a period of not less than 2 hours. The test pressures of other piping systems are specified in Table 15044.
- B. Verification that the pipes have been cleaned and properly isolated shall be made.
- C. The maximum length of line to be tested as one section shall be 2,500 linear feet.
- D. The Contractor is responsible for providing all equipment required to perform the cleaning and testing of the piping and for performing the work.
- E. Pressure testing of potable water lines shall be in accordance with AWWA C900.
- F. Pressure testing of chemical solution lines shall be in accordance with AWWA C900.

### 3.02 TESTING PREPARATION

- A. Pipes shall be in place and anchored before performing the pressure testing.
- B. Conduct hydrostatic and pneumatic tests on exposed and above ground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
- C. Where any section of the piping contains concrete thrust blocks or encasement, do not make the pressure test until at least 10 days after the concrete has been poured. When testing mortar-lined piping, fill the pipe to be tested with water and allow it to stand full for at least 48 hours to absorb water before conducting the pressure test.
- D. Before conducting hydrostatic tests, the pipes must be cleaned. Mains 8" in diameter and larger shall be cleaned using a poly-pig. Mains smaller than 8" in diameter may be cleaned by the flushing required prior to disinfection of the piping, using potable water at a minimum velocity of 2.5 feet per second to remove the dirt and debris. Prior to any flushing operations, the Contractor shall notify the Owner and the Engineer for coordination. Flushing and/or cleaning of mains smaller than 10" requires a minimum of 48 hours advance notice and flushing and/or cleaning of mains 10" and larger requires a minimum advance notice of 1 week. An Owner's representative and/or an Engineer's representative shall be present during all flushing and all flushing shall take place during off-peak demand periods.

- E. Test new pipelines which are to be connected to existing pipelines by isolating the new line from the existing line by means of pipe caps, special flanges, or blind flanges. After the new line has been successfully tested, remove caps or flanges and connect to the existing piping.
- F. Conduct hydrostatic tests on buried pipe after the trench has been completely backfilled. The pipe may be partially backfilled and the joints left exposed for inspection for an initial leakage test. Perform the final test, however, after completely backfilling and compacting the trench.

### 3.03 TESTING

#### A. Chemical Solution Piping:

- 1. The allowable leakage for chemical solution piping is zero. If the leakage exceeds the allowable amount or the test pressure varies more than plus or minus 5 psi, the test is considered failed. Should the test fail, the Contractor shall determine the reason(s) the test failed, correct the problems, and repeat the testing until the test passes.

#### B. Potable Water and Hydrant Branch.

- 1. All air shall be purged while the piping is being filled. Once all of the air is removed, the piping system shall be subjected to the required test pressure for a preliminary test. All joints, fittings, valves, and connections shall be examined for leaks. Correct leaks prior to starting the actual test.
- 2. Test piping subject to the National Fire Code requirements per NFPA 24. Once all visible leaks have been repaired, the test pressure (200 PSI) shall be applied and maintained for a period of 2 hours by means of a hydraulic pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from the pump suction container to maintain  $\pm 5$  psi of the test pressure. The allowable rate of leakage shall not exceed 2 quarts per hour per 100 gasketed joints (19 milliliters per hour per joint), plus other applicable allowances under NFPA 24.

**TABLE 15044  
PIPING PRESSURE TEST SCHEDULE**

Type of Piping	Identification	Test Pressure (in psig)
Chemical Solution	CS	150
Sodium Hypochlorite	SH	150
Potable Water	PW	

**END OF SECTION**

**SECTION 15062  
DUCTILE IRON PIPE AND FITTINGS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. The scope of work includes the provision and installation of ductile iron pipe as shown on the Drawings and as specified herein.
- B. Related Work Described Elsewhere includes the following:
  - 1. Materials and Equipment are included in Section 01600.
  - 2. Painting is included in Section 09900.
  - 3. Piping and Equipment Identification System is included in Section 09905.
  - 4. Pressure Testing of Piping is included in Section 15044.
- C. QUALITY ASSURANCE
- D. The materials shall be in accordance with the following standards:
  - 1. Cement mortar lining for water: AWWA/ANSI C151/A21.51.
  - 2. Push-on and mechanical joints: AWWA/ANSI C111/A21.11.
  - 3. Ductile iron pipe: AWWA/ANSI C151/A21.52.
  - 4. Ductile iron pipe fittings: AWWA/ANSI C153/A21.53 (350 PSI)
  - 5. Ductile iron pipe flanged pipe and connections: AWWA/ANSI C115/A21.15
- E. All ductile iron pipe and fittings shall be furnished by manufacturers as listed on the Approved Products and Approval Process (Appendix D), Orange County Utilities Standards and Construction Specifications Manual.
- F. The Contractor shall obtain from the pipe manufacturers a certificate of inspection to the effect that the pipe and fittings supplied for this Contract have been inspected at the project site and that they meet the requirements of these Specifications. All pipe and fittings shall be subject to visual inspection at time of delivery by rail or truck and just before they are placed into the trench. Joints or fittings that do not conform to these Specifications will be rejected and must be removed immediately by the Contractor.

1.02 SUBMITTALS

- A. Product Specifications



1. Product specifications from the manufacturer shall be submitted to the Engineer for approval in accordance with General Conditions and Section 01340.

B. Affidavit of Compliance

1. The Contractor shall furnish an Affidavit of Compliance certified by the pipe manufacturer that the pipe, fittings, and specials furnished under this Contract comply with all applicable provisions of current AWWA and ASTM standards, NSF 61, and these Specifications. No pipe or fittings will be accepted for use in the Work on this project until the Affidavit has been submitted and approved by the Engineer.
2. The Owner reserves the right to sample and test any pipe or fitting after delivery and to reject all pipe and fittings represented by any sample which fails to comply with the specified requirements.

1.03 DELIVERY, STORAGE AND HANDLING

- A. All pipe shall be shipped and stored at the jobsite with wood lagging between pipes such that pipes do not make contact with one another.
- B. Extra care shall be exercised when handling cement lined pipe. Damage to the lining will render it unfit for use.

1.04 JOB CONDITIONS

- A. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such material has entered the pipelines, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

1.05 WARRANTY AND GUARANTEES

- A. Product warranties shall be provided in accordance with Section 01740 - Warranties and Bonds.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All wetted materials shall be NSF 61 approved.
- B. All pipe and fittings shall be clearly marked with the trademark or name of the manufacturer, the batch number, the location of the project, the thickness class, and applicable standards.

- C. Manufacturers' shall submit an affidavit with the shop drawings indicating NSF 61 approval for the materials used in products that come into contact with the potable water, in accordance with Rule 62555.320(3) FAC.
- D. All underground pipe joints and fittings shall be restrained using restraining glands as specified in Section 15100.

## 2.02 MATERIALS AND EQUIPMENT

### A. Pipe

1. All ductile iron pipe shall be cement lined and in conformance with AWWA/ANSI C151/A21.52.
2. Underground piping shall be pressure class 350 for 12-inch diameter and smaller and shall be mechanical joint. Underground pipe shall have an asphaltic coating in accordance with AWWA C151.
3. All above ground piping shall be thickness class 53 and shall be flanged. Above ground pipe shall have a factory applied primer suitable for painting in accordance with Section 09900.
4. Flanges on flanged pipe shall be threaded and shall be flat faced. All gaskets shall be full faced 1/8" Toruseal gaskets or approved equals. Bolts, nuts, and gaskets shall be in accordance with AWWA/ANSI C115/A21.15 and shall be 316 stainless steel.

### B. Fittings

1. All fittings shall be cement lined and shall conform to AWWA/ANSI C153/A121.53.

## PART 3 - EXECUTION

### 3.01 PREPARATION

#### A. Pipe Inspection

1. All piping shall be inspected and tested at the foundry.
2. The Owner shall have the right to have any or all piping, fittings or special castings inspected and tested by an independent testing agency at the foundry or elsewhere. Such inspection and testing will be at the Owner's expense.
3. Pipe and fittings shall be inspected prior to installation. All pipe lengths or fittings showing a crack, damaged lining, or receiving a severe blow that may cause an incipient fracture shall be marked as rejected and immediately removed from the job site. Portions of damaged pipe lengths may be used if

the damaged portions and 12" past the damaged portions are cut off providing the remaining pipe is sound.

B. Location of Existing Utilities

1. The location of existing water lines and valves in all connection areas shall be located prior to beginning construction in that area. Any discrepancies between the Drawings and field conditions shall be brought to the attention of the Engineer of Record prior to construction in that area.
2. It will be the Contractor's responsibility to verify all existing utilities (electric, gas, telephone, water, sewer, etc.) on site, whether shown by the Drawings or not. Any damage to existing utilities shall be repaired immediately by the Contractor or by the particular utility. If the contractor performs the repairs, they shall be performed under the direct authorization and supervision of the particular utility. All costs of repairs shall be paid by the Contractor. Any discrepancies between the Drawings and field conditions shall be brought to the attention of the Engineer of Record prior to construction in that area.

3.02 INSTALLATION

A. General Installation Requirements

1. Installation shall be performed in accordance with the applicable provisions of AWWA C600 and the manufacturer's recommendations
2. Piping shall be installed along straight line and grade between fittings unless other lines of alignment or grade changes have been indicated. Modifying alignments or grades during construction must be approved by the Engineer prior to installation.
3. Pipe, fittings, valves, and accessories shall be installed as shown or indicated on the Drawings.
4. All connections to existing piping systems shall be made as shown or indicated on the Drawings after coordination and cooperation with Owner representatives. Some such connections may have to be made during off-peak hours (late night or early morning).
5. Whenever it is desirable to deflect pipe joints to avoid obstructions or to maintain required alignment, the amount of the joint deflection shall not exceed 80 percent of the maximum limits allowed by the pipe manufacturer.
6. Aboveground and exposed piping shall be cut accurately to measurements established at the job site and shall be worked into place without springing or forcing, properly clearing all equipment access areas and openings. Changes in sizes shall be made with appropriate reducing fittings. Pipe connections shall be made in accordance with the details shown and manufacturer's recommendations. Open ends of pipe lines shall be properly capped or plugged during installation to keep dirt and other foreign material out of the

system. Pipe supports and hangers shall be provided where indicated or as required to insure adequate support of the piping.

B. Handling and Cutting Pipe

1. Care shall be taken in handling, cutting, and laying ductile iron pipe and fittings to avoid damaging the pipe and interior coat tar epoxy or cement mortar lining, scratching or marring machined surfaces, and abrasion of the pipe coating. All cracked pipe and fittings shall be removed at once from the Work at no additional cost to the Owner.
2. Pipe cutting shall be done in a neat workmanlike manner without creating damage to the pipe and interior coal tar epoxy or cement mortar lining. Ductile iron pipe may be cut using an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw, milling wheel saw or oxyacetylene torch. Cut ends and rough edges of ductile iron pipe shall be ground smooth. For push-on joint connections, the cut end shall be beveled to prevent gasket damage during joint assembly. Interior lining shall be repaired at cut ends per the manufacturer's instructions prior to joint assembly.

C. Assembling joints

1. Push-on joints:
  - a. Insert the gasket into the groove of the ball.
  - b. Uniformly apply a thin film of special lubricant over the inner surface of the gasket that will contact the spigot end of the pipe.
  - c. Insert the chamfered end of the plain pipe into the gasket and push until it seats against the bottom of the socket.
2. Mechanical joints:
  - a. Thoroughly clean, with a wire brush, surfaces that will be in contact with the gaskets.
  - b. Lubricate the gasket, bell and spigot by washing with soapy water.
  - c. Slip the gland and gasket, in that order, over the spigot and insert the spigot into the bell until properly sealed.
  - d. Evenly seat the gasket in the bell at all points, center the spigot, and firmly press the gland against the gasket.
  - e. Insert the bolts, install the nuts finger tight, and progressively tighten diametrically opposite nuts uniformly around the joints to the proper tension with a torque wrench.
3. Flanged joints:
  - a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate bolts with oil and graphite.

- b. Insert the nuts and bolts (or studs) finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- c. Care shall be used when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight with no visible leakage under operational or testing conditions.

D. Fabrication:

1. Tapped connections:

- a. Make all tapped connections as shown on the Drawings or as directed by the Engineer.
- b. Make all connections watertight and of adequate strength to prevent pullout.
- c. Drill and tap normal to the longitudinal axis of the pipe.

2. Cutting:

- a. Perform all cutting with machines having rolling wheel cutters or knives designed to cut ductile iron. The use of a hammer and chisel to cut pipe is prohibited.
- b. After cutting, examine all cut ends for possible cracks.
- c. Carefully chamfer all cut ends to be used with push-on joints to prevent damage to gaskets when pipe is installed.

E. Installing Interior Piping:

1. All piping and fittings shall be installed true to alignment and rigidly supported thrust anchors shall be provided where required. Any damage to linings shall be repaired to the satisfaction of the Engineer before the pipe is installed. Each length of pipe shall be cleaned out before installation.
2. Sleeves shall be installed of proper size for all pipes passing through floors or walls as shown on the Drawings and indicated in Section 15100.
3. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be, in accordance with the requirements of the piping layout and jointing method and their locations shall be verified from approved piping layout drawings and the structural drawings.
4. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, a certification shall be submitted stating that such requirements have been complied with.

F. Pipe deflection

1. The maximum deflection in any direction shall not exceed 80% of the manufacturer's recommendations.

3.03 INSPECTION AND HYDROSTATIC PRESSURE AND LEAKAGE TESTING

- A. All piping shall be pressure and leakage tested in accordance with Section 15044.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 15065  
UNDERGROUND PIPING AND FITTINGS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

Scope or Work:

- A. This section specifies the requirements for furnishing all labor, materials, equipment and incidentals required, and install and test the underground process and sodium hypochlorite solution piping, fittings and appurtenances specified herein.
- B. Related Work Described Elsewhere:
  - 1. Trenching, Bedding and Backfilling are included in Section 02320.
  - 2. Piping, Valve, and Equipment Identification System is included in Section 09905.
- C. General Requirements:
  - 1. The provision, installation, and testing of all piping, fittings, valves, and other accessories shall be in accordance with the latest edition of the Orange County Water and Sewer Standards.
  - 2. Potable water piping shall be DIP for 4 inches and larger pipe diameter, and PVC for smaller than 4 inches. Sodium hypochlorite piping shall be PVC as indicated herein and on the design drawings.

1.02 QUALITY ASSURANCE

- A. All piping shall be in accordance with the specifications herein. See Section 15062 for Ductile Iron Pipe and Fittings, and Section 15070 for PVC Pipe and Fittings.

1.03 SUBMITTALS

- A. Product literature and data on the pipe, fittings, valves and other accessories shall be submitted in accordance with Section 01340 Submittals.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Pipe and fittings shall be handled and stored in a manner which will ensure installation in sound, undamaged condition. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks,



padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated pipe shall be stored off the ground on wide padded skids. Whenever the storage period on the job exceeds 30 days, plastic pipe shall be covered or otherwise protected from exposure to sunlight.

1.05 WARRANTY AND GUARANTEES

- A. Provide standard manufacturer equipment warranties.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All pipe and fittings shall be clearly marked with the trademark or name of the manufacturer, the batch number, the location of the plant, the pressure class, and applicable standards.
- B. Manufacturers' shall submit an affidavit with the shop drawings indicating NSF 61 approval for the materials used in products that come into contact with the potable water, in accordance with Rule 62555.320(3) FAC.

2.02 POTABLE WATER PIPING

- A. Refer to Section 15062 for DIP Pipe and Fittings and Section 15070 for PVC Pipe and Fittings.

2.03 SODIUM HYPOCHLORITE PIPING – PVC PIPE AND FITTINGS

- A. Refer to Section 15070.

**PART 3 - EXECUTION**

3.01 INSTALLATION

- A. Potable water piping and sodium hypochlorite piping shall be installed as follows:
  - 1. Trench Preparation and Pipe Bedding
    - a. The trench preparation and pipe bedding shall be in accordance with Section 02320 and the design drawing details.
  - 2. Pipe Preparation and Handling

- a. All pipe and fittings shall be inspected prior to lowering into trench to ensure no cracked, broken, or otherwise defective materials are being used.
  - b. The Contractor shall clean the ends of pipe thoroughly and remove foreign matter and dirt from the inside of pipe and keep the pipe clean during and after laying.
  - c. The Contractor shall use proper implements, tools, and facilities for the safe and proper protection of the WORK. The Contractor shall lower pipe into the trench in such a manner as to avoid any physical damage to the pipe and shall remove all damaged pipe from the job site. Care shall be taken to not drop or dump pipe into trenches under any circumstances.
3. Trench Dewatering and Drainage Control
- a. Trench dewatering and drainage control shall be in accordance with Section 02240. The Contractor shall prevent water from entering the trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall not be laid in water.
4. Survey Line and Grade
- a. Pipe shall be laid to the lines and grades shown on the design drawings, within a tolerance of plus or minus 0.10 feet. The Contractor shall provide line and grade stakes at 25' intervals. The Contractor shall provide Temporary Bench Marks (TBM'S) on site. The minimum pipe depth shall be three (3) feet below the finished grade surface.
5. Pipe Installation in Trench
- a. The Contractor shall prevent foreign material from entering the pipe while it is being placed in the trench. The Contractor shall remove all foreign material from the pipe or joint ring before the next pipe is placed. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into the pipe, the County Engineer or designee may require that snugly-fitted, tightly-woven canvas bags be placed over each end before lowering the pipe. The bags shall be left in place until the connection is to be made to the adjacent pipe. During laying operations, the Contractor shall keep debris, tools, clothing, or other materials out of the pipe.
6. Installation of PVC Pipe
- a. All PVC pipe shall be installed in accordance with standards set forth in the UNI-BELL "Handbook of PVC Pipe Design and Construction"

unless such standards conflict with these specifications in which case these specifications shall apply.

7. Laying of Pipes on Curves
  - a. Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflections at the joints. Maximum deflections at pipe joints and laying radius for the various pipe lengths shall be as recommended by the pipe manufacturer.
8. Pipe Restraining
  - a. General
    - i. All pressure pipe, fittings, mechanical joints, and other items shall be restrained with restraining assemblies as specified herein and as shown on the design drawing details. The use of thrust blocks for pressure pipe and fittings shall be prohibited.
  - b. Restrained Joint Construction
    - i. Sections of piping shall be constructed using pipe and fittings with restrained "Locked-type" joints (Tyton Joint with Field Lok Gasket) manufactured by U. S. Pipe and Foundry Company or equal. The joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure. Any restrained joints that allow for elongation upon pressurization will not be allowed in those locations where the pipe comes out of the ground.
  - c. Mechanical Restraining Devices
    - i. Mechanical restraining devices as specified herein may be substituted for the restrained "Locked-Type" joints manufactured by the ductile iron pipe and fitting manufacturer. The restraining devices shall be "Megalug 2000PV" or approved equal.
  - d. Joint Restraint Devices
    - i. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized

mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C153/A21.53. Twist-off nuts shall be used to ensure proper actuating of the restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

9. PIPE MARKING

- a. Pipe marking shall be in accordance with Section 09905 and the drawing details.

B. Crossing of Water Mains and Sewer Mains

1. Water mains shall be above the sewer whenever they cross.
2. Adequate structural support for both the water main and sewer mains shall be provided to prevent excessive deflection of joints and settling.
3. If separation is less than required, sewers shall be constructed of ductile iron pipe with mechanical joints and the length of the ductile iron pipe shall be a minimum of 18 feet and centered at the point of crossing so that the joints will be equidistant and as far as possible from the water main.

3.02 HYDROSTATIC TESTING OF PRESSURE PIPING

- A. Refer to Section 15044.

3.03 FINAL CLEANING

- A. Prior to Final Inspection and acceptance of the potable water piping and sodium hypochlorite piping, Contractor shall flush and clean all portions of the system. Flushing and cleaning shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the system at or near the downstream end. Disposal of the flushing water shall be the Contractor's responsibility.
- B. Upon the County's final inspection of the proposed pipe systems, if any foreign matter is still present in the system, Contractor shall clean the sections and portions of the lines as required.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**SECTION 15070  
POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, and install and test in the locations as shown on the Drawings, the polyvinyl chloride piping, fittings and appurtenances specified herein.

1.02 RELATED WORK

- A. Piping, Valve, and Equipment Identification System is included in Section 09905.
- B. Valves and Appurtenances are included in Section 15100.
- C. Pipe Hangers and Supports are included in Section 15126.
- D. Pressure Testing of Piping is included in Section 15044.

1.03 GENERAL DESIGN

- A. PVC piping shall be installed in the locations as show on the Drawings. All plastic pipe and fittings shall conform to this specification section whether provided as a part of an equipment "package" or purchased separately by the Contractor.

1.04 QUALITY ASSURANCE

- A. All plastic pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications.

1.05 SUBMITTALS

- A. Affidavit of Compliance
  - 1. The Contractor shall furnish an Affidavit of Compliance certified by the pipe manufacturer that the pipe, fittings, and specials furnished under this Contract comply with all applicable provisions of current AWWA and ASTM standards, NSF 61, and these Specifications. No pipe or fittings will be accepted for use in the Work on this project until the Affidavit has been submitted and approved by the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. PVC pipe shall be delivered to the Site in unbroken bundles packaged in such manner as to provide protection against damage. When possible, pipe shall be stored at the Site in the unit packages until ready for use. Packaged units shall be handled using a fork lift or a spreader bar with fabric straps. Packaged units shall not be stacked at the Site higher than two units high.

- B. When it is necessary to store PVC pipe for more than 30 days, exposure to direct sunlight shall be prevented by covering the pipe with an opaque material. Adequate air circulation above and around the pipe shall be provided as required to prevent excessive heat accumulation. PVC pipe shall not be stored close to heat sources or hot objects such as heaters, fires, boilers or engine exhaust. Pipe gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The interior and all sealing surfaces of pipe, fittings and other appurtenances shall be kept clean and free of dirt and foreign matter.
- C. Care shall be taken in handling and laying pipe and fittings to avoid severe impact blows, crushing, abrasion damage, gouging or cutting. Pipe shall be lowered, not dropped, from trucks or into trenches. All cracked, damaged or defective pipe and fittings, or any length of pipe having a gouge, scratch or other permanent indentation of more than 10 percent of the wall thickness in depth, shall be rejected and removed at once from the Work and replaced with new acceptable pipe at no additional cost to the Owner.

#### 1.07 WARRANTY AND GUARENTEES

- A. Provide equipment warranty in accordance with Section 01740 - Warrantees and Bonds.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL

- A. All materials that come into contact with potable water or sodium hypochlorite shall be NSF 61 approved for use in contact with potable water. Manufacturers shall submit an affidavit with the shop drawings indicating approval by the EPA or NSF for the materials used in products that come into contact with the water, in accordance with Rule 555.320(3) Florida Administrative Code.

#### 2.02 MATERIALS AND EQUIPMENT

##### A. PVC Pipe

1. Pipe shall be made of polyvinyl chloride, Schedule 80 pipe, conforming to ASTM D1785. Schedule 80 pipe shall have solvent welded joints. PVC pressure pipe shall bear the approved seal of the National Sanitation Foundation (NSF). PVC pipe that is exposed to sunlight shall be manufactured with additives to provide resistance to ultraviolet deterioration
2. All hard plumbed piping shall be PVC. All fittings shall be solvent welded. All flange gaskets, union seals, valve seals and piping seals shall be fully compatible for their intended use. The orientation of the piping connections, access openings, and other appurtenances shall be as indicated on the drawings. Piping shall be routed such that it does not impede mobility around the site or block access to any equipment, doors or hatches.

##### B. Fittings

1. Tank fittings are covered under section 13209.

2. Fittings shall be socket type and shall conform to ASTM D-246.
  3. Threaded fittings shall only be used where approved by Engineer. Threaded fittings shall be pressure rated for at least one-half of the rating for socket fittings, and shall conform to ASTM D-2464.
  4. Three unions of each size supplied shall be provided as spares, boxed and labeled for storage by owner.
- C. Flanges
1. Slip-on flanges shall be provided to connect to flanged valves, fittings, or equipment. Flanges shall match the connecting flanges on the adjacent fitting, valve or piece of equipment.
  2. Flanges for Schedule 80 PVC pipe shall be PVC rated for a 150 psi working pressure with ANSI B 16.1 dimensions and bolting pattern. Flanges shall be connected to PVC piping with solvent welded joints in accordance with ASTM D2467. Gaskets shall be Viton, full faced type with a minimum thickness of 1/8-inch. Nuts and bolts shall be hexagonal with machine threads, manufactured of Titanium. Titanium flat washers shall be used against PVC flanges.
- D. Solvent Cement
1. PVC solvent cement shall be IPS Weld-On CPVC 724 Cement Gray in conjunction with Weld-On P-70 Purple Primer.
- E. Threaded Lubricant
1. Threaded connections shall only be used where approved by Engineer.
  2. Lubricant for Schedule 80 threaded connections shall be Teflon tape only, MIL Spec, P-27730A.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install PVC pipe where shown on the Drawings and in strict accordance with the manufacturer's technical data and printed instructions.
- B. Joints for Schedule 80 PVC pipe and fittings shall be solvent welded. All joints shall be made watertight. All pipe cutting, threading and jointing procedures for solvent welded and threaded PVC pipe joints shall be in strict accordance with the pipe and fittings manufacturer's printed installation instructions. Thread lubricant for threaded connections shall be Teflon tape only. In making solvent welded connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth, if necessary and apply solvent cement of proper grade.
- C. Installation of valves and fittings shall be strictly in accordance with the manufacturer's instructions. Particular care shall be taken not to over-stress threaded connections at sleeves. In making solvent weld connections the solvent shall not be spilled on valves or allowed to run from joints.



- D. All piping shall have sufficient number of unions to allow convenient removal and shall be approved by the Engineer.
- E. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify their locations from the approved Drawings.
- F. Piping Identification:
  - 1. Prior to attaching labeling and identification, all surfaces shall be cleaned of all dirt, grease and other foreign matter.
  - 2. Pipes shall be labeled and identified in accordance with Section 09905.
  - 3. Pipes shall be labeled empty, following the pressure testing.

3.02 INSPECTION AND PRESSURE TESTING

- A. All piping shall be pressure tested in accordance with Section 15044.
- B. All piping joints shall be visibly inspected for leaks. All leaks found shall be repaired.

**END OF SECTION**

**SECTION 15100  
VALVES AND PIPING APPURTENANCES**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: The scope of work includes the furnishing of all labor, materials, equipment and appurtenances required for the complete installation of all valves and associated appurtenances as shown on the Drawings and as specified herein.
- B. Related Work Described Elsewhere.
  - 1. Piping, Valve, and Equipment Identification System is included in Section 09905.
  - 2. Pipe Hangers and Supports are included in Section 15126
  - 3. Pressure Testing of Piping is included in Section 15044.
- C. General Design
  - 1. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water, chemicals, etc., depending on the application.
  - 2. The equipment includes, but is not limited to the following:
    - a. Gate Valves
    - b. PVC Ball Valves
    - c. PVC Butterfly Valves
    - d. Joint Restraints
    - e. Expansion Joints
    - f. Curb Stops
    - g. Hose Bibbs
    - h. Emergency Eyewash/Shower
    - i. Backflow Prevention Assemblies
    - j. Pipe and Valve Identification

1.02 QUALITY ASSURANCE

- A. All of the valves and appurtenances specified herein shall be products of well established reputable firms who are fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with standard practices and methods and shall comply with these specifications as applicable.

1.03 SUBMITTALS

- A. Submit manufacturer's product literature for all equipment to demonstrate compliance with this Specification and information on the Drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. The equipment provided under this section shall be shipped, handled and stored in accordance with the Manufacturer's written instructions and in accordance with Section 01600: Material and Equipment.

1.05 WARRANTY AND GUARANTEES

- A. Provide equipment warranties in accordance with Section 01740.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. Valves shall include the required accessories such as operators, operating nuts, valve boxes, handwheels, chain wheels, extension stems, etc. necessary for proper operation.
- B. All valves and appurtenances shall be of the size shown on the Drawings. All similar type valves shall be from the same manufacturer.
- C. All valves and appurtenances shall have the name of the manufacturer and the working pressure for which they are rated cast in raised letters upon the body.
- D. All bolts, washers and nuts shall be Type 304 stainless steel, unless specified otherwise.
- E. Factory Finishing:
  - 1. Epoxy Lining and Coating:
    - a. Linings and coatings shall be in accordance with AWWA C550, as applicable, unless otherwise specified.
    - b. Linings and coatings shall be either two-part liquid material or heat-activated (fusion) material. Only heat-activated material is acceptable if specified as "fusion" or "fusion bonded" epoxy.
    - c. Linings and coatings shall be a minimum of 7-mil dry film thickness except where limited by valve operating tolerances.
- F. Materials

1. All wetted materials shall be NSF 61 approved. Manufacturer's shall submit an affidavit with the product literature indicating NSF 61 approval, in accordance with Rule 62-555.320(3) Florida Administrative Code.
2. Brass and bronze valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.
3. Approved alloys are of the following ASTM designations:
  - a. B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
  - b. Stainless steel Alloy 18-8 may be substituted for bronze.

## 2.02 MATERIAL AND EQUIPMENT

### A. GATE VALVES

1. Valves 12-inches and smaller shall be gate valves, unless otherwise noted in the specifications.
2. Gate valves shall be flanged NRS resilient wedge type rated for 250 p.s.i. working pressure and shall meet or exceed AWWA C515. Valve bodies, bonnets, wedges and hand wheels shall be constructed of ductile iron. The exterior of the ductile iron wedges shall be fully encapsulated with EPDM rubber. The wedges shall be symmetrical and seal equally well with flow in either direction.
3. The gate valve stems and wedge nuts shall be copper alloy and the NRS stems shall have an integral thrust collar. The wedge nut shall be independent of the wedge and held in place on three sides by the wedge.
4. Valves shall be NSF 61 certified.
5. All gaskets shall be pressure energized O-ring type seals. Stems shall be sealed by three (3) O-rings. The top two o-rings shall be replaceable with valve fully open and while subject to full rated working pressure.
6. Valves shall have thrust washers located with one (1) above and one (1) below the thrust collar to assure trouble-free operation of the valve.
7. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly.
8. Gate valves 12 inches and smaller shall be Series 2500 by American Flow Control, Series F-6100 by Clow, or Series A-2360 by Mueller.

### B. PVC BALL VALVES

1. PVC ball valves shall be of one piece capsule type manufactured of Type 1, Grade 1 PVC. Ball valves shall be true union design with two-way blocking

capability and shall have solvent welded socket ends. Vented PVC ball valves shall be furnished for sodium hypochlorite services.

2. Ball valves shall have Teflon seats with Viton backing cushions and Viton O-ring seals, and shall be designed for a 150 psi working pressure at 120°F. Valves shall be supplied with ABS lever operating handles.
3. PVC ball valves shall be Type 21 manufactured by Asahi/America, or an equal approved by the Engineer.

#### C. BUTTERFLY VALVES

1. Butterfly valves 4 inches in size and smaller, shall be manufactured of Type 1, Grade 1 PVC, and designed for a minimum working pressure of 150 psi at 70 degrees F. Butterfly valves shall be of the bubble tight closing Viton seat type. Valve discs shall rotate 90 degrees from the fully open position to the fully closed position.
2. Valve bodies shall be wafer style with only liner and disc as wetted parts. Bolt pattern shall conform in dimensions and drilling to ANSI B16.1, Class 125.
3. Valve seats and o-rings shall be Viton, and stem shall be titanium. The seat ring shall be capable of compensating for changes in direction of flow to assure a bubble tight seal in either direction.
4. Valve discs shall be solid constructed of PVC.
5. All butterfly valves shall open left or counter-clockwise when viewed from the stem. Manual valves located above ground shall be equipped with a locking lever operator.
6. Butterfly valves shall be Type 57 manufactured by Asahi/America, or an equal approved by Engineer.

#### D. Joint Restraints

##### 1. Mechanical Joints

- a. Joint restraints for mechanical joint fittings 3” through 48” shall be constructed of ductile iron conforming to ASTM A536 and shall have a working pressure rating of 350 PSI for 3–16 inch fittings and 250 PSI for 18-48 inch fittings.
- b. Restraint shall be accomplished by multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C110/A21.10.
- c. Restraints shall be Megalug Series 1100 restraints with Mega-Bond coating as manufactured by EBBA Iron or approved equal.

##### 2. Pipe Joints

- a. Joint restraints for push-on pipe joints 3” through 48” shall be constructed of ductile iron conforming to ASTM A536 and shall have

a working pressure rating of 350 PSI for 3–16 inch fittings and 250 PSI for 18-48 inch fittings.

- b. Restraint shall be accomplished by a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell. Torque limiting twist off nuts shall be used to insure proper actuation of the restraining wedges.
- c. Restraints shall be Megalug Series 1700 Megalug restraint harnesses with Mega-Bond coating as manufactured by EBBA Iron or approved equals.

#### E. Expansion Joints

1. Expansion joints shall be of the molded bellows design with 5 convolutions manufactured of PTFE fluorocarbon conforming to ASTM D1457. Wall thickness shall be 0.077 inches or greater with less than 5% deviation at any point of the bellows. Joints shall be flanged suitable for 150 psi water working pressure and in accordance with ANSI B16.1 dimensions and bolting patterns.
2. Flanges and T-bands of Pureflex Durcor-62 shall be provided. Bolts, nuts, and washers shall be titanium. Limit cables of 30355 and spray shield shall be provided.
3. Expansion joints shall be Flexi-Joint 4 FIBA 5 S1 with spray shield, or equal approved by Engineer.

#### F. Curb Stops

1. Curb stops shall be bronze, ball type, B44-444W by The Ford Meter Box Co., 6100 W-22 by A.Y. McDonald, or P25146 by Mueller.

#### G. Hose Bibbs

1. Hose bibbs shall be brass, heavy duty, 2002 HD with 72001 vacuum breaker by A.Y. McDonald or equal.

#### H. Emergency Eyewash/Shower

1. Emergency eyewash/shower shall be Model 8320 CRP with Model 9001 Flow Switch and Alarm, and Model SP157A Bleed Valve by Haus Corp., or equal.

#### I. BACKFLOW PREVENTION ASSEMBLIES

1. Backflow prevention assemblies shall consist of reduced pressure principle devices and isolation valves manufactured in accordance with AWWA C506, latest revision, American Society of Sanitary Engineering Standards, and the University of Southern California Foundation for Cross Connection Control and Hydraulic Research "Manual of Cross Connection Control," Sixth Edition.
2. The backflow prevention devices shall include an integral sensing system that will automatically open a relief valve whenever the differential pressure

between the inlet supply and the reduced pressure zone drops to 2 psi. The relief valve shall remain open until a positive pressure differential of 2 psi is reestablished. If pressure upstream of the first check valve drops to atmospheric or below, the relief valve shall remain fully open providing an internal air gap between the first check valve and the water level in the reduced pressure zone. The unit shall also be constructed such that any minor leakage of the second check valve will result in visible flow from the relief valve, even if the first check valve is totally disabled.

3. The backflow prevention devices shall have bronze bodies for sizes 2 1/2-inches and smaller and ductile iron bodies for sizes 3 inches and larger. Ductile iron bodies shall be coated with a fusion bonded thermosetting epoxy coating in accordance with AWWA C550 with a minimum, holiday-free, coating thickness of 12 mils. The reduced pressure back flow preventer shall consist of two independently operated, spring loaded, wye pattern, poppet type check valves designed for installation in a normal horizontal flow attitude. An independent spring loaded relief valve shall be located between the two check valves. Check valve assemblies, springs and seats, and all other internal parts shall be constructed of Type 316 stainless steel. Relief valve body and trim shall be constructed of bronze. Check valve and relief valve seats shall be field replaceable without removing the device from the service line. Back flow preventers shall be designed for a working pressure of 200 psi and a temperature range of 32°F to 140°F. The back flow preventer shall be manufactured as a complete unit including test cocks and upstream and downstream isolation gate valves. The test cocks shall be manufactured of bronze and shall be arranged such that the unit can be tested without removing the unit from the line.
  4. The backflow prevention assemblies shall be furnished with isolation valves factory assembled. For sizes 2 1/2-inches and smaller, the isolation valves shall be all bronze ball valves with Buna N O-rings and valve seats, and a lever operating handle. Ball valves shall be in accordance with AWWA C800, latest revision. For sizes larger than 3 inches, the isolation valves shall be resilient seated gate valves with flanged ends and OS&Y handwheel operators. Gate valves shall be as specified in this section.
  5. The backflow prevention devices shall be coated similar to gate valves specified in this section.
  6. Backflow prevention assemblies shall be Model 825Y assemblies manufactured by Febco, Model 975XL assemblies as manufactured by Wilkins, or approved equal.
- J. Pipe and Valve Identification
1. Identification systems for above-ground and below-ground valves shall be as specified in Section 09905.

## 2.03 INSTALLATION

### A. General:

1. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Valves shall be installed in accordance with manufacturer's installation instructions and with the details shown on the Drawings. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.
2. Valves shall be installed such that they are supported properly in their respective positions, free from distortion and strain. Valves shall be installed such that their weight is not borne by pumps and equipment that are not designed to support the weight of the valve.
3. Valves shall be carefully inspected during installation; they shall be opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat: Check and adjust all valves for smooth operation.
4. After installation, all valves and appurtenances shall be tested at least 2 hours at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the Engineer.
5. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of these structures. In addition, install hangers or supports at all changes in direction at the spacing requirements stated in Section 15126 Pipe Hangers and Supports.
6. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections in Division 15.
7. Flanged joints shall be made with 304 stainless steel bolts, nuts and washers, unless otherwise noted. Mechanical joints shall be made with mild corrosion resistant alloy steel bolts and nuts. All exposed bolts shall be painted the same color as the pipe. All buried bolts and nuts shall be heavily coated with two (2) coats of bituminous paint, Tnemec Series 46 – 465, Carboline Bitumastic 50, or equal.
8. Clean iron flanges by wire brushing before installing flanged valves. Clean threaded joints by wirebrushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.



9. Pressure gauges shall not be installed until after the substantial completion date unless otherwise requested by the Engineer.
10. Valve boxes with the concrete bases shall be installed for each buried valve as shown on the drawings. The valve box shall be centered accurately over the operating nut and the entire assembly shall be plumb. The tops of valve boxes shall be adjusted to the proper elevation as specified below and as shown on the drawings.
  - a. In paved areas, top of valve box covers shall be set flush with pavement. Following paving operations, a 30-inch square shall be neatly cut in the pavement around the box and the paving removed. The top of the box shall then be adjusted to the proper elevation and a 30-inch square by 6-inch thick concrete pad poured around the box cover. Concrete pads in traffic areas shall be reinforced with No. 4 reinforcement bars as shown on the drawings. Concrete for the pad shall be 3,000 psi compressive strength at 28 days.
  - b. In unpaved areas, tops of valve box covers shall be at least 2 inches above finished grade. After the top of the box is set to the proper elevation, a 30-inch square by 6-inch thick concrete pad shall be poured around the box cover. Concrete for the pad shall be 3,000 psi compressive strength at 28 days.
  - c. The concrete pad for the valve box cover shall have a 3-inch diameter, bronze disc embedded in the surface as shown on drawings. The bronze disc shall have the following information neatly stamped on it: the size of the valve; the number of turns to open; the direction to open; and the year of installation.
11. Valve Orientation:
  - a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
  - b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above finished floor, unless otherwise shown.
12. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls or plaster ceilings for valve access.
13. Floor Box and Stem: Steel extension length shall locate operating nut in floor box.
14. Valves shall be tested hydrostatically, concurrently with the pipeline in which they are installed. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure used for the pressure test(s). If valve joints leak during pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.

15. Following installation, all above-ground valves shall be painted in accordance with the painting system specified in Section 09900. Following installation of buried valves or valves installed in valve vaults, repair any scratches, marks and other types of surface damage, etc., with a coating equal to the original coating supplied by the manufacturer. Prior to backfilling, all nuts, bolts, and other parts of the valve joints shall be coated with two coats, 10 mils DFT per coat, of bituminous paint, Tnemec Series 46 – 465, Carboline Bitumastic 50, or equal.
16. Expansion and Contraction Provisions
  - a. Rigidly support all piping with adequate provisions for expansion and contraction.
  - b. Firmly anchor horizontal runs over 50 feet in length at the midpoint of the runs to force expansion equally toward the ends.
17. Support valves in accordance with Section 15126.
18. Pipe sleeves and wall castings shall be provided at the locations called for on the Drawings. These units shall be as detailed and of the material as noted on the Drawings. They shall be accurately set in the concrete or masonry to the elevations shown. All wall sleeves and castings required in the walls shall be in place when the walls are poured. Ends of all wall castings and wall sleeves shall be of a type consistent with the piping to be connected to them.
19. Link seals for wall sleeves shall be installed in strict accordance with the manufacturer's printed installation instructions. For watertight applications in tanks or treatment units, the link seal installation shall be tested hydrostatically for leaks at the same time as the tank or treatment unit. Any leaks that occur during the test period shall be repaired by checking the link seals for proper installation and replacement of unit(s) found to be defective at no additional cost to the Owner.
20. Pipe couplings shall be installed in strict accordance with the manufacturer's published instructions and recommendations.
21. Tie rods shall be installed in strict accordance with the manufacturer's written installation requirements. Unless otherwise indicated on the Drawings, the size and number of tie rods for a joint or installation shall be as recommended by the manufacturer's design chart for a working pressure of 150 psi.
22. Following installation and prior to backfilling, all parts of the buried tie rod joint restraint system, including tie rods, tie bolts, nuts, washers, and other fasteners, shall be coated with two coats, 10 mils DFT per coat, of bituminous paint, Tnemec Series 46 – 465, Carboline Bitumastic 50, or equal.
23. Backflow preventions assemblies shall be installed at the locations shown on the Drawings and shall be installed in accordance with the manufacturer's installation instructions, local codes, and as shown on the Drawings. Assemblies shall be tested by a certified tester and the appropriate report submitted to the City utilities department.

24. Reduced pressure principle back flow preventers shall be installed horizontally with an 18-inch minimum clearance between the finished grade and the lowest point on the bottom of the unit. Reduced pressure back flow preventers shall be installed with provisions for a suitable drain arrangement to drain off discharges from the relief valve, so that discharges are not objectionable. Back flow preventers shall be installed such that they are easily accessible for testing, maintenance, and repair.
25. Piping, fittings, and the air release valves shall be installed as shown on the Drawings. The air release valve assemblies shall be installed so that they are properly supported and such that they will function properly and freely and no parts shall be strained. Air release valve testing shall be performed during the testing of pipeline which air release is attached.

**END OF SECTION**

**SECTION 15126  
PIPE HANGERS AND SUPPORTS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Furnish and install all pipe supports as indicated and as specified herein.
- B. Related Work Described Elsewhere:
  - 1. Schedule 80 Polyvinyl Chloride (PVC) Pipe and Fittings is included in Section 15070.
- C. General Design:
  - 1. The Drawings depict only minimum pipe support locations. Adequate pipe supports shall be supplied for all piping systems to provide a rigid overall installation and additional support for pipe ends when equipment is disconnected.

1.02 QUALITY ASSURANCE

- A. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate tensile strength of the material, assuming 10 feet of water filled pipe being supported.
- B. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification stating that such requirements have been complied with.

1.03 SUBMITTALS

- A. Submit manufacturer's descriptive literature for all pipe support devices and materials demonstrating compliance with this Specification and the support details shown on the Drawings.

1.04 DELIVERY STORAGE AND HANDLING

- A. The equipment provided under this section shall be shipped, handled and stored in accordance with the Manufacturer's written instructions, and in accordance with Section 01600: Material and Equipment.

#### 1.05 WARRANTY AND GUARANTEES

- A. Provide equipment warranty in accordance with Section 01740: Warranties and Bonds.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL

- A. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and cure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe, and personal contact. All pipe supports shall be approved prior to installation.
- B. The Contractor shall select and design all piping support systems with the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.
- C. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them through the project.
- D. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be of the proper size, strength, and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
- E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.
- F. Hangers and support shall be space in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed 4 feet unless otherwise specified herein.
- G. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by ITT Grinnel Co., Inc., Carpenter and Patterson, Inc., or equal. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product, and shall not be considered as propriety. Any item

comparable in type, style, quality, design, and performance will be considered for approval.

## 2.02 MATERIALS AND EQUIPMENT

### A. Pipe Hangers and Supports for Plastic Pipe:

1. Single plastic pipes shall be supported by pipe supports as previously specified herein.
2. Individual clamps, hangers, and supports in contact with plastic pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

## **PART 3 - EXECUTION**

### 3.01 PREPARATION

- A. Prior to prime coating, all pipe hangers and supports shall be thoroughly clean, dry and free from all mill-scale, rust, grease, dirt, paint, and other foreign substances to the satisfaction of the Engineer.
- B. All pipe supports shall be galvanized and prime coated with Tnemec Series 66 - 1211 or approved equal.
- C. Finish coating shall be compatible with the prime coating used and shall be applied as specified in Section 09900: Painting.

### 3.02 INSTALLATION

- A. All pipes, horizontal and vertical, shall be rigidly supported from the building structure by approved supports. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specified herein. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless it is so indicated on the Drawings, or specifically directed or authorized by the Engineer.
- B. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement, and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the Engineer.
- C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings, and sleeve type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

- D. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.
- E. Standard Pipe Supports:
  - 1. Horizontal Suspended Piping:
    - a. Single Pipes: Adjustable swivel-ring, splint-ring, or clevis hangers.
    - b. Grouped Pipes: Trapeze hanger systems.
    - c. Furnish galvanized steel protection shield and oversized hangers for all insulated pipe.
    - d. Furnish precut sections of rigid insulation with vapor barrier at hangers for all insulated pipe.
    - e. Metal shall be painted galvanized steel.
  - 2. Horizontal Piping Supported from Walls:
    - a. Single pipes shall use wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
    - b. Stacked Piping
      - i. Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
      - ii. Piping clamps which resist axial movement of pipe through support not acceptable.
    - c. Wall mounted piping clips not acceptable for insulated piping.
    - d. Wall mounted pipe support systems in the containment area shall be vinyl ester.
  - 3. Horizontal Piping Supported From Floors:
    - a. Floor Mounted Channel Supports:
      - i. Use for piping smaller than 3 inch nominal diameter running along floors and in trenches at piping elevations lower thank can be accommodated using pedestal pipe supports.
      - ii. Attach channel framing to floors with anchor bolts.
      - iii. Attach pipe to channel with clips or pipe clamps.
      - iv. Channel framing, clips, clamps, and fasteners shall be vinyl ester.

### 3.03 PAINTING

- A. All fabricated steel pipe supports, saddles, brackets, rolls, clevises and the like shall be galvanized painted, primed, and after installation, as specified in Section 09900.

**END OF SECTION**

## **SECTION 16010**

### **BASIC ELECTRICAL REQUIREMENTS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Basic Electrical Requirements specifically applicable to Division 16 sections in addition to Division 1 - General Requirements.

##### **1.02 GENERAL CONDITIONS FOR ALL WORK**

- A. All Work must closely be coordinated among the electric utility, the construction manager, and the Owner.

##### **1.03 SCOPE OF WORK**

- A. Provide complete electrical system for the facility including but not limited to:
  - 1. Panelboard
  - 2. Pump Control Panel (PCP)
  - 3. Fire Alarm Control Panel (FACP)
  - 4. Circuit Breaker
  - 5. Wire and Cable
  - 6. Conduit Drawings
- B. Provide conduits to serve the electrical system as shown on the drawings:
- C. Provide surge suppressors where indicated on the drawings.
- D. Provide site grounding.
- E. Provide all testing and startup services.
- F. Each bidder or his authorized representatives shall, before preparing a bid, visit all areas of the proposed site in which work will take place and be performed to inspect carefully the present conditions. The submission of the bid by this bidder shall be considered evidence that the bidder has visited the project and noted the locations and conditions under which the work will be performed and that the bidder takes full responsibility for a complete knowledge of all factors governing his work.



- G. All necessary temporary power, control and instrumentation requirements are the responsibility of the Contractor and shall be furnished at no extra cost to the Owner. Power and controls shall be furnished to all existing equipment at all times.
- H. Pay all fees required for permits, inspections, and connections.

#### **1.04 REFERENCES**

- A. ANSI/NFPA70-National Electrical Code.

#### **1.05 SUBMITTALS**

- A. Include products specified in the following sections:
  - 1. Section 16100 – Raceways, Boxes and Cabinets
  - 2. Section 16120 – Wires and Cables
  - 3. Section 16160 – Panelboards
  - 4. Section 16195 – Electrical Identification
  - 5. Section 16450 – Grounding System
  - 6. Section 16500 – Lighting Systems
  - 7. Section 16709 – Surge Protection Devices (SPD)
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.
- D. Indicate applicable specification section on each submitted document.

#### **1.06 REGULATORY REQUIREMENTS**

- A. Conform to applicable Building Codes for project location.
- B. Electrical: Conform to NFPA 70 - 2011 Edition.
- C. Occupational Safety and Health Administration (O.S.H.A.).
- D. Obtain permits and request inspections from authority having jurisdiction.

#### **1.08 CONDUIT DRAWINGS**

- A. In addition to the manufacturer's equipment shop drawings, the CONTRACTOR

shall submit for approval, electrical installation working drawings for the pump station building and the site electrical containing the following:

1. Concealed and buried conduit layouts shown on floor plans drawn at not less than 1/4-inch = 1-foot-0-inch scale. The layouts shall include locations of process equipment, panelboards, control panels and equipment, switches, large junction or pull boxes, instruments, and any other electrical devices connected to concealed or buried conduits.
2. Plans shall be drawn on high quality reproducible, double sided mylar, size 36-inch x 24-inch, and shall be presented in a neat, professional manner.
3. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

#### **1.09 OPERATION AND MAINTENANCE DATA**

- A. Submit complete operations and maintenance data for all equipment furnished under this Division in accordance with Section 01340 manuals shall be prepared specifically for this installation and shall include all required cuts, Drawings, equipment lists, descriptions, complete part lists, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

#### **1.10 WARRANTY**

- A. Provide a warranty for all the electrical equipment in accordance with the requirements of other sections, but in no case less than three (3) years from date of substantial completion.

#### **PART 2 - PRODUCTS (Not Applicable)**

#### **PART 3 - EXECUTION**

##### **3.01 INSTALLATION**

- A. Electrical systems shall be complete and operable for the intended purpose in accordance with applicable codes at the time of acceptance.
- B. The Contractor shall coordinate all activities with the construction manager and the Owner.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

## **SECTION 16100**

### **RACEWAYS, BOXES, AND CABINETS**

#### **PART 1 - GENERAL**

##### **1.01 SUBMITTALS**

- A. Provide submittals for all electrical equipment enclosures.

##### **1.02 REFERENCES**

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Comply with NECA "Standard of Installation."

##### **1.03 LISTING AND LABELING**

- A. Provide products specified in this Section that are UL listed and labeled.

#### **PART 2 - PRODUCTS**

##### **2.01 CONDUIT**

- A. PVC Conduit and Tubing Fittings: NEMA TC 3; Schedule 80, match to conduit or conduit/tubing type and material.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3; Schedule 40, match to conduit or conduit/tubing type and material.

##### **2.02 BOXES**

- A. Outlet and Device Boxes: Use 1 of the following:
  - 1. Nonmetallic Boxes: NEMA OS2.
- B. Hinged Cover Enclosures: Stainless steel enclosure with continuous hinge cover and flush latch. The enclosure shall be provided with stainless panel insert for mounting equipment. Outdoor enclosures shall be 316 NEMA 4X Stainless Steel.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Seal all outdoor raceways using duct seal.
- B. Use the following wiring methods:
  - 1. Underground: PVC Schedule 40 Concrete encased, except elbows shall be rigid aluminum.
  - 2. Schedule 80 PVC conduit shall be used where shown on the Drawings and in chemical rooms and chlorine storage areas or areas designated "CORROSIVE" on the Drawings.
  - 2. Instrumentation (shielded cable): PVC. Provide #10 ground wire in all conduits containing shielded conductors.
  - 3. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquid tight flexible non-metal conduit.
  - 4. Boxes and Enclosures:
    - a. 316 NEMA 4X stainless steel. All hardware shall be stainless steel.
- C. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- D. Install raceways level and square and at proper elevations. Provide adequate headroom.
- E. Complete raceway installation before starting conductor installation.
- F. Use temporary closures to prevent foreign matter from entering raceway.
- G. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- H. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated keep the legs of a bend in the same plane and the straight legs of offsets parallel.

- I. Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical, and leave at least 1-inch (25 mm) concrete cover.
  - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  - 2. Space raceways laterally to prevent voids in the concrete.
  - 3. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.
  
- J. Install underground raceways:
  - 1. At least 18" below grade.
  - 2. At least 24" below driveways and roads.
  - 3. All buried ductbanks to be concrete encased 3000 psi color red concrete.
  
- K. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
  - 1. Run parallel or banked raceways together, on common supports where practical.
  - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
  
- L. Join raceways with fittings designed and approved for the purpose and make joints tight.
  - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
  - 2. Use insulating bushings to protect conductors.
  
- M. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
  
- N. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used,

align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

- O. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb (90kg) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.
- P. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling, threaded inside for plugs, and set flush with the finished floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.
- Q. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- R. Install hinged cover enclosures and cabinets plumb. Support at each corner.
- S. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

## **END OF SECTION**

## SECTION 16120

### WIRES AND CABLES

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish, install and test all wire, cable, and appurtenances as shown on the Drawings and as hereinafter specified.

##### 1.02 SUBMITTALS

- A. Samples of proposed wire and cable shall be submitted for approval. Each sample shall have the size, type of insulation, UL listing and voltage stenciled on the jacket.
- B. Approved samples will be sent to the project location for comparison by the Resident Engineer with the wire actually installed.
- C. Installed, unapproved wire shall be removed and replaced at no additional cost to the Owner.

##### 1.03 APPLICATIONS

- A. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type XHHW. Below grade and underground the wire shall be type XHHW.
- B. Wire for circuits over 150 volts to ground shall be NEC type XHHW for sizes 4/0 AWG and smaller.
- C. Single conductor wire for control, indication and metering shall be type MTW No. 14 AWG, 19 strand or type XHHW No. 14 AWG stranded.
- D. Multi-conductor control cable shall be No. 14 AWG, 19 strand.
- E. Wire for process instrumentation or shielded control cable shall be No. 16 AWG, shielded and stranded.

##### 1.04 MINIMUM SIZES

- A. Except for control and signal leads, no conductor smaller than No. 12 AWG shall be used.



## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. All wires and cables shall be of annealed, 98 percent conductivity, soft drawn stranded copper conductors.

### **2.02 600 VOLT WIRE AND CABLE**

- A. Type RHW and XHHW shall be cross-linked polyethylene (XLP); as manufactured by the Southwire Co., Collyer Insulated Wire Co., Rome Cable or approved equal.

### **2.03 INSTRUMENTATION AND CONTROL CABLE**

- A. Process instrumentation wire shall be twisted pair, 600V, cross-linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed, type "XLP" as manufactured by the American Insulated Wire Co., Eaton Corp. "Polyset," or approved equal. Multi-conductor cables shall be supplied with individually shielded twisted pairs.
- B. Multi-conductor control cable shall be stranded, 600V, cross-linked polyethylene insulated with PVC jacket, type "XLP" as manufactured by the American Insulated Wire Co., Eaton Corp. "Polyset," or approved equal.

### **2.04 TERMINATIONS AND SPLICES**

- A. Power Conductors: Terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling.
- B. Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors per termination. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors. Heat shrink boots shall be utilized for all outdoor splices.
- C. Instrumentation Signal Conductors (including graphic panel, alarm, low and high level signals): Terminations permitted shall be typical of control conductors. Splices are allowed at instrumentation terminal boxes only.
- D. Except where otherwise approved by the Engineer no splices will be allowed in manholes, handholes or other below grade located boxes.

- E. Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc.), conduit bodies, etc.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
- B. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. listed for use with the insulation specified.
- C. Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.
- D. Shielded instrumentation wire shall be installed in rigid steel conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from control cables in manholes.
- E. Shielding on instrumentation wire shall be grounded at one end only, as directed by supplier of the instrumentation equipment.
- F. Wire and cable connections to terminals and taps shall be made with compression connectors. Connections of insulated conductors shall be insulated and covered. All connections shall be made using materials and installation methods in accordance with instructions and recommendations of the manufacturer of the particular item of wire and cable. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.
- G. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or approved by the Engineer as the manufacturer of the particular item of wire and cable.
- H. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.
- I. All control and instrumentation circuits and wiring shall be clearly and permanently numbered and labeled at each end so as to identify the location of the opposite end and the function of the circuit. Individual wires in a multi-wire circuit shall be

identified with wire numbers. Labeling shall be in place prior to turnover of any equipment, system or sub-system to Owner.

### **3.02 TESTS**

- A. All 600-volt wire insulation shall be tested with a meg-ohmmeter after installation. Tests shall be made at not less than 1,000 VDC.

**END OF SECTION**

## **SECTION 16160**

### **PANELBOARDS**

#### **PART 1 - GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor materials, equipment and incidentals required and install all panelboards as hereinafter specified and as shown on the Drawings.

#### **PART 2 - PRODUCTS**

##### **1.02 RATING**

- A. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.
- B. Panelboards installed outdoors shall be NEMA 4X SS type enclosure unless otherwise noted.

##### **1.03 STANDARDS**

- A. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

##### **1.04 CONSTRUCTION (NEMA 4X SS)**

- A. Interiors:
  - 1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the antiturn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.
  - 2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.
  - 3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

4. A nameplate shall be provided listing panel type, number of circuit breakers and ratings.

B. Buses:

1. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.
2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.
4. Buses for 120/208V light panels shall be rated 10,000 amperes RMS symmetrical.

C. Boxes:

1. Recessed boxes shall be made from galvanized code gauge steel without multiple knockouts. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.
2. Surface mounted boxes shall have an internal and external finish as hereinafter specified in paragraph D4.
3. At least 4 interior mounting studs shall be provided.
4. All conduit entrances shall be field punched.

D. Trim:

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover

shall be furnished on each door.

3. The trims shall be fabricated from code gauge sheet steel.
4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
5. Trims for flush panels shall overlap the box by at least 3/4-inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

E. Manufacturer:

1. 120/240V, single phase, 3-wire, and 120/208V 3-phase, 4-wire panelboards shall be as manufactured by Square D, Eaton Cutler-Hammer or Siemens.
2. 480V, 3-phase, 3-wire panelboards shall be as manufactured by Square D, Eaton Cutler-Hammer or Siemens.

**1.05 CIRCUIT BREAKERS:**

- A. Panelboards shall be equipped with circuit breakers as shown on the Drawings.
- B. Circuit breakers shall be molded case, bolt-in type.
- C. Circuit breakers used in 120/240 and 120/208V panelboards shall have an interrupting capacity of not less than 10,000 - amperes, RMS symmetrical.
- D. GFCI (ground fault circuit interrupter) shall be provided for circuits where indicated on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and an interrupting capacity of 10,000 amperes RMS.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Boxes for surface mounted panelboards shall be mounted so there is at least 1/2-inch air space between the box and the wall.
- B. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6-feet

0-inch above the floor, properly aligned and adequately supported independently of the connecting raceways.

- C. All wiring in panelboards shall be neatly formed, grouped, laced, and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the cardholder inside the front cover.

**END OF SECTION**

## **SECTION 16195**

### **ELECTRICAL IDENTIFICATION**

#### **PART 1 - GENERAL**

##### **1.01 WORK INCLUDED**

- A. Nameplates and tape labels.
- B. Wire and cable markers.
- C. Color coding.

##### **1.02 SCOPE**

- A. Provide engraved nameplates for the following equipment as indicated on the drawings:
  - 1. Label all compartments.
  - 2. Label all outdoor junction boxes.
  - 3. Label control system panels.
- B. All wires shall be marked and color-coded.
- C. All control wiring shall have wire numbers on each end.
- D. All exposed conduits to be painted to match color of back wall.

#### **PART 2 - PRODUCTS**

##### **2.01 MATERIALS**

- A. Nameplates: Engraved three-layer laminated plastic, black letters on a white background.
- B. Wire and Cable Markers: Pre-printed self-sticking type.
- C. Color Coding Tape: Vinyl plastic insulating tape, colors as specified in part 3.

#### **PART 3 - EXECUTION**



### 3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates and tape labels.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.

### 3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. Any color coding schemes used in existing work shall be maintained in new work.
- C. Conductor Color Coding: Provide color coding for feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

<u>240/120 Volts</u>	<u>Phase</u>	<u>120/208 Volts</u>
Black	A	Black
Red	B	Red
-	C	Blue
White	Neutral	White
Green	Ground	Green

### 3.03 NAMEPLATE ENGRAVING

- A. Provide nameplates to identify all electrical distribution and control equipment and loads served. Letter Height: 1/8 inch for individual switches and loads served for distribution and control equipment identification.
- B. Panelboards: 1/4 inch; identify equipment designation. 1/8 inch; identify voltage rating and source.
- C. Individual Circuit Breakers, Switches, and in Panelboards: 1/8 inch; identify circuit and load served, including location.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

## SECTION 16450

### GROUNDING SYSTEM

#### PART 1 - GENERAL

##### 1.01 Scope of Work

- A. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

##### 1.02 Related Work

- A. Conduit shall be as specified under Section 16100.
- B. Wire shall be as specified under Section 16120.

#### PART 2 - PRODUCTS

##### 2.01 Materials

- A. Ground rods: Ground rods shall be copperclad steel 3/4-inch x 30 foot. Ground rods shall be Copperweld or be an approved equal product.

#### PART 3 - EXECUTION

##### 3.01 General

- A. Tie into existing grounding system.
- B. Grounding electrodes shall be driven as required. Where rock is encountered, grounding plates may be used in lieu of grounding rods.
- C. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and similar items shall be grounded.
- D. Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or approved equal. All buried connections shall be made by welding process equal to Cadweld.
- E. The grounding grid conductors shall be embedded in backfill material around the structures.

- F. All underground conductors shall be laid slack and where exposed to mechanical injury shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard.
- G. The Contractor shall exercise care to insure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

### **3.02 Tests**

- A. The Contractor shall test the ground resistance of the system. The Engineer shall be notified forty-eight (48) hours before tests are made to enable the Owner to have designated personnel present. All test equipment shall be provided by the Contractor and approved by the Engineer. Dry season resistance of the system shall not exceed 5 ohms. If such resistance cannot be obtained with the system as shown, the Contractor shall provide additional grounding as directed by the Engineer, without additional payment. The Contractor shall submit all grounding system test results to the Engineer for review.

**END OF SECTION**

## SECTION 16500

### LIGHTING SYSTEM

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish and install complete lighting systems including panelboards, transformers, lighting fixtures, receptacles, switches, contractors, clocks and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.

##### 1.02 STANDARDS

- A. All lighting fixtures shall be in accordance with the National Electrical Code and shall be constructed in accordance with the latest edition of the Underwriters Laboratories "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be Underwriters Laboratories labeled.

##### 1.03 RELATED WORK

- A. Panelboards shall be as specified under Section 16160.
- B. Conduit shall be as specified under Section 16100.
- C. Wire shall be as specified under Section 16120.

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS

- A. Switches:
  - 1. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to Federal Specification W-S-896-D.
  - 2. Wall switches shall be of the following types and manufacturer or approved equal.
    - a. Single pole - Arrow-Hart No. 1991 or Leviton No. 1221-2.
    - b. Double pole - Arrow-Hart No. 1992 or Leviton No. 1222-2.

- c. Three way - Arrow -Hart No. 1993 or Leviton No. 1223-2.
- d. Four way - Arrow-Hart No. 1994 or Leviton No. 1224-2.
- e. Single pole, key operated - Arrow-Hart No. 1991-L or Leviton No. 1221-2L.
- f. Momentary contact, 2 circuit, center off - Arrow-Hart No. 1895 or Leviton No. 1256.
- g. Weatherproof cover for Arrow-Hart 2900 series tap action switches - Arrow-Hart Catalog No. 2881-G.

B. Receptacles:

- 1. Wall receptacles shall be of the following types and manufacturer or approved equal.
  - a. Single, 20A, 125V, 1P, 3W; Arrow-Hart No. 5361 or Leviton No. 5361.
  - b. Duplex, 20A, 125V, 2P, 3W; Arrow-Hart No. 5362 or Leviton No. 5362.
  - c. Corrosion-resistant, duplex, 20A, 125V, 2P, 3W; Arrow-Hart No. 5739-CR or Leviton No. 5362CR and Crouse-Hinds WLRD-1 cover.
  - d. 60A, 480V, 3P, 2W; weatherproof receptacle shall be Crouse-Hinds Catalog No. ARE6324 with Crouse-Hinds Catalog No. APJ 6385 plug.
  - e. Ground fault interrupter, duplex, 20A, 125V, 3P, 2W; Arrow-Hart No. GF5362 or Leviton No. 6899.
  - f. Stainless steel indoor mounting plate for G.F.I. receptacle; Arrow-Hart Catalog No. S-26.
  - g. Clock hanger, 15A, 125V, 2P, 3W; Arrow-Hart No. 452 or Leviton No. 628.
  - h. Single, 20A, 250V, 2P, 3W; Arrow-Hart No. 5461 or Leviton No. 5461.
  - i. Single, 30A, 125V, 2P, 3W; Arrow-Hart No. 5716N; cap: Arrow-Hart No. 5717N or Leviton No. 5371.
  - j. Clothes dryer, 30A, 125/250V, 3P, 3W; Arrow-Hart No. 9344N. Cap: Arrow-Hart No. 9352AN or Leviton No. 5209 and No. 9382-P.
- 2. Receptacles (Weatherproof/NEMA 4 Areas/Outside)
  - a. General Requirements: Receptacles in wet locations shall be installed with a hinged outlet cover/enclosure clearly marked "Suitable for Wet Locations While In Use" and "UL Listed". There must be a gasket between the enclosure and the mounting

surface, and between the hinged cover and mounting plate/base to assure proper seal. Taymac; Specification Grade.

3. Special wiring devices shall be provided as noted of the drawings.
  - a. Tamper resistant duplex receptacle Leviton No. 5262-SG or approved equal.
  - b. Wall switch occupancy sensor Leviton No. 6775 or approve equal.
  - c. Scene select microprocessor dimmer Leviton No. 17765 or approved equal.
  - d. Surge protective duplex receptacle Leviton No. 5380 or approved equal.

C. Device Plates:

1. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be 302 (18-8) high nickel stainless steel of the same manufacturer as the device.
2. Plates for surface mounted device boxes shall be of the same material as the box.

D. Lighting Fixtures:

1. Lighting fixture types shall be as shown on the "Lighting Fixture Schedule" on the Drawings. See below listing of manufacturers.

E. Lamps:

1. Metal halide lamps shall be deluxe white of the size and type as called for in the Lighting Fixture schedule on the Drawings.
2. Metal halide ballasts shall be of the constant wattage auto-transformer type of the correct size and voltage for the fixture it is to serve as called for in the Lighting Fixture Schedule on the Drawings. All ballasts shall be as manufactured by Sylvania Electric Products, Inc., General Electric Company, or Jefferson Electric Company.
3. All lamps shall be of one manufacturer and shall be as manufactured by Hubble Lighting, SESCO Lighting, Sylvania Electric Products, Inc., General Electric Company, or Westinghouse Electric Corporation or approved equal.



F. Flexible Fixture Hangers:

1. Flexible fixture hangers used in nonhazardous areas shall be Type ARB and flexible fixture supports used in hazardous areas shall be Type ECHF as manufactured by the Crouse-Hinds Company or approved equal.
2. Steel channel, roll formed into U-shape, shall be used to span between building steel for mounting of fixtures where required by fixture location or as indicated on the Drawings. Channel shall be as manufactured by Unistrut Corporation or approved equal.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.
- B. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.
- C. Flexible fixture hangers shall be used for all pendant mounted fixtures.
- D. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.
- E. Receptacles in process areas and shops shall be mounted 36 inches above the floor unless otherwise noted on the Drawings.
- F. Receptacles in office and other like areas shall be mounted 18 inches above the floor unless otherwise noted on the Drawings.

#### **3.02 SPARE LAMPS**

- A. Spare lamps shall be provide for all fixture types supplied. Quantity shall be 15 percent of total used on project.

**3.03 CLEANING UP**

- A. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

**END OF SECTION**

**THIS PAGE LEFT BLANK INTENTIONALLY**

## SECTION 16709

### SURGE PROTECTION DEVICES (SPD)

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

- A. The specified unit shall provide effective high energy transient voltage surge suppression, surge current diversion and high frequency noise attenuation in all electrical modes for equipment connected downstream from the facility's meter or load side of the main overcurrent device. The unit shall be connected in parallel with the facility's wiring system.

##### 1.02 RELATED DOCUMENTS AND APPLICABLE STANDARDS

- A. Systems shall be designed, manufactured, tested and installed in accordance with the following applicable documents and standards:
1. Underwriters Laboratories (UL1449 3<sup>rd</sup> Addition and UL 1283)
  2. ANSI/IEEE (C62.41 and C62.45)
  3. Military Standards (MIL – STD 220A)
  4. National Electric Code (NEC)
  5. Underwriter's Laboratories 248

#### PART 2 - PRODUCTS

##### 2.01 APPROVED MANUFACTURER

###### Current Technologies

Power & Systems Innovations  
PO Box 590223  
Orlando, FL 32859-0223

Contact: John West Sr.  
Phone (407) 380-9200  
Phone (800) 260-2259  
FAX (407) 380-3911 FAX  
E-mail [jwest@psihq.com](mailto:jwest@psihq.com)

Internet [www.psihq.com](http://www.psihq.com)

Joslyn, AKA (Total Protection Solutions)

Total Protection Solutions  
4366 LB McLeod Road  
Orlando, FL 32804

Contact: Bob Levit  
Phone 407-841-4405  
FAX 407-841-4407  
E-mail: [bob@treborpowersystems.com](mailto:bob@treborpowersystems.com)  
Internet [www.treborpowersystems.com](http://www.treborpowersystems.com)

Surge Suppression Inc

Surge Suppression Incorporated  
P.O. Box 674  
Destin, FL 32540-0674

Contact: Mike Barton  
Phone (888) 987-8877  
FAX (888) 900-8879  
E-mail [mbarton@surgesuppression.com](mailto:mbarton@surgesuppression.com)

## 2.02 DEVICES

- A. Surge Protection Devices (SPD's) shall be UL listed at or above the available fault current level at the point of SPD application by UL, Per UL 1449 latest edition.
- B. The SPD shall be a parallel design using fast-acting energy protection that will divert and dissipate the surge energy.
- C. Units shall have:
  - a. Minimum 10 mode operation for all 3 phase Y and high leg Delta configurations and six modes of protection for all 3 phase Delta "no Neutral" configurations.
  - b. One nanosecond or less response time for any individual component, and shall be self restoring and fully automatic.

- c. Extended noise filtration with a 10 kHz to 100 MHz range.
- d. LED indication of unit failure to indicate the continuous positive operational status of each protected phase.
- e. System Voltage shall be as indicated on the drawings.
- f. The fusing system shall be capable of allowing the rated maximum single impulse surge current to pass through without fuse operation.
- g. SPD's shall be installed with leads as short as possible (not to exceed 24 inches). SPD's may be mounted internally in Motor Control Centers, switchgear and switchboards. SPD's shall be mounted externally at panelboards and control panels.
- h. All SPD panel units shall be guaranteed by the installing contractor and surge suppression manufacturer to be free of defects in materials and workmanship for a period of not less than 10 years from the date of substantial completion of the system to which the suppressor is installed.
- i. For each SPD type or size used on this project provide the following submittal data:
  - 1. Complete schematic data for suppressor, indicating part numbers, dimensional drawings and mounting arrangement.
  - 2. Cut sheets which include Peak Surge Current "per mode", Let Through Current, UL tested voltage protection rating (VPR) and maximum Continuous Operating Voltage (MCOV).
  - 3. Copy of Warranty Statement

## **2.03 APPLICATIONS**

- A. Surge Current RATING OF 40 kA PER MODE AT 208 or 240 Volt three phase or single phase branch panels.

## **2.04 FILTERING**

- A. The system shall provide a UL 1283 Listed Electromagnetic Interference Filter

capable of attenuating noise levels produced by electromagnetic interference and radio frequency interference.

## **2.05 FUSING**

- A. Fuse component(s) identification and surge rating. The manufacture shall provide documentation demonstrating the tested surge current rating (8x20µsec) of the fuse. The surge rating of the fuse shall be greater than the combined surge current rating of all downstream connected suppression elements.
- B. Fusing: Suppression component(s) identification and surge rating. The manufacturer shall provide documentation identifying the suppression element(s) connected in series with fuse element(s) and provide the suppression elements published 8x20µsec surge current rating. The rating of the suppression element(s) shall be less than the rating of upstream fusing element(s).
- C. Fusing: Surge performance. All fusing shall be required to meet the single pulse surge current testing requirements of Section 2.2 above.
- D. Fusing: Isolation. The unit shall have each MOV fused and designed to operate only in the event of an MOV failure within the SPD device.
- E. Fusing Coordination: Units that can't demonstrate MOV-fuse coordination in 2.4.a and 2.4.d are not acceptable.
- F. Fusing: UL Rating. All fusing shall be 200kAIC UL248 Recognized.

## **2.06 UL 1449 SUPPRESSED VOLTAGE RATING.**

- A. The unit shall be UL 1449 3rd Edition Listed and shall be as follows for L-N, L-G, N-G, and L-L, modes, inclusive of the disconnect switch: (Select appropriate product rating from below)
  - 1. 40kA – 80kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700
  - 2. 100kA – 150kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700
  - 3. 200kA – 300kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700

## **2.07 IN-FIELD TESTING**

- A. The unit shall be equipped with a performance data extraction protocol allowing unit performance data, including percent of protection remaining, to be transmitted to an internal, external status analyzer.

## **2.08 ENCLOSURE.**

- A. Outside - Units shall be provided in a NEMA type 4X plastic enclosure.

## **PART 3 – EXECUTION**

### **3.01 SYSTEM TESTING**

- A. Upon completion of installation, a factory-authorized local service representative shall provide product startup testing services. The tests shall include:
  - 1. On-line Testing: Verification that all suppression and filtering paths are operating with 100% protection as well as verification of proper facility neutral-to-ground bond by measuring neutral-to-ground current and voltage.
  - 2. Off-line Testing: Impulse injection to verify the system tolerances as well as verification of proper facility neutral-to-ground bond. To be compared to factory benchmark test parameters supplied with each individual unit.

### **3.02 DOCUMENTATION AND REPORTING**

- A. A copy of the startup test results and the factory benchmark testing results shall be supplied to the engineer and the owner for confirmation of proper system function. This letter shall also clarify that the integrity of all neutral-to-ground bonds were verified through testing and visual inspection, and that all grounding bonds were observed to be in place.

### **3.03 SYSTEM WARRANTY**

- A. The TVSS system manufacturer shall warranty the entire system against defective materials and workmanship for a period of ten (10) years following substantial completion.



**END OF SECTION**

## **Appendix B**

### **Forms**

**THIS PAGE LEFT BLANK INTENTIONALLY**

**APPENDIX B**

**FORMS**

**Pressure Test**

February 11, 2011

Project Name: _____						<input type="checkbox"/> Force Main <input type="checkbox"/> Reclaimed Main <input type="checkbox"/> Water Main		<b>Allowable Loss – 2 Hours</b> $L = \frac{SD(P)}{148,000} \times \frac{1}{2}$ See Note Below						
Constructed by: _____														
DATE	LINE SEGMENT	STATION		LENGTH	N	D	START		END		LOSS (gal)		Pass /Fail STATUS	
		From	To				Time	PSI	Time	PSI	Allow	Actual		
COUNTY Inspector's Name:						Signature:						Date:		
Tester's Name:						Signature:						Date:		
Comments:														

**Note:** L - Allowable leakage in gallons per hour.  
 S - Length of pipe tested, in feet.  
 D - Nominal diameter of the pipe in inches.  
 P - Average test pressure during leakage test in pounds per square inch gauge.

**APPENDIX B**

**FORMS**

**Water Main Disinfection Certification**

February 11, 2011

This form is required to schedule and document the disinfection of newly installed water mains to AWWA C-651 – latest revision. The CONTRACTOR shall complete the top portion of this form to document the subject water main, disinfection method and amount of chlorine applied. The UTILITIES inspector will document the residuals at each sample point on the bottom portion of this form.

Date Requested: \_\_\_\_\_  
 CONTRACTOR's Name: \_\_\_\_\_  
 Project Name: \_\_\_\_\_  
 Project Number: \_\_\_\_\_  
 Location: \_\_\_\_\_ Plan Sheet No.(s): \_\_\_\_\_  
 Starting Location: \_\_\_\_\_ Ending Location: \_\_\_\_\_  
 Line Length: \_\_\_\_\_ Line Size: \_\_\_\_\_  
 Pipe Material: \_\_\_\_\_ Type of Joint(s): \_\_\_\_\_  
 Gallons to Fill Pipe: \_\_\_\_\_ Pounds of Chlorine Applied: \_\_\_\_\_  
 Method of Disinfection Used: \_\_\_\_\_  
 CONTRACTOR's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**For COUNTY Use Only**

Certification Information

Start Time: \_\_\_\_\_ Start PSI: \_\_\_\_\_  
 Stop Time: \_\_\_\_\_ Stop PSI: \_\_\_\_\_

<i>Sample Point Number</i>	<i>Sample Point Location</i>	<i>Initial Chlorine Reading, Minimum 25 ppm Required</i>	<i>24 Hr Chlorine Reading, Minimum 10 ppm Required</i>

Lab Test Results

Passed: \_\_\_\_\_ Failed: \_\_\_\_\_ Incomplete: \_\_\_\_\_

Comments:

\_\_\_\_\_  
 \_\_\_\_\_

Inspector's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**THIS PAGE LEFT BLANK INTENTIONALLY**

## **Appendix C**

### **Permits Obtained By the County**

**THIS PAGE LEFT BLANK INTENTIONALLY**





REISS ENGINEERING

January 24, 2013

Ms. Dennise Judy  
Florida Department of Environmental Protection  
3319 Maguire Blvd.  
Suite 232  
Orlando, FL 32803-3767

RECEIVED  
FEB 12 2013  
DEP Central District

RE: Courtesy Notification  
Orange County EWRF Hypochlorite Storage Improvements  
Permit No. FL 0038849

Dear Ms. Judy,

Reiss Engineering, Inc. (REI) is currently designing improvements to Orange County's Eastern Water Reclamation Facility (EWRF) Hypochlorite system. In our previous discussions regarding permitting this project, you stated that a FDEP permit is not required because we will be replacing existing equipment with similar equipment using the same chemical. As you requested, this letter provides a courtesy notification that the hypochlorite storage improvements will be bid and begin construction this year.

Please feel free to contact me with any questions at 407-679-5358.

Sincerely,

REISS ENGINEERING, INC.

Curtis I. Kunihiro, P.E.

DEP DOMESTIC WASTE SEC.	
PROJECT	OCUD
	Eastern WRF
PERMIT	FL0038849
BY	DATE 2/14/13
RECEIPT ACKNOWLEDGED	



# FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

BOB MARTINEZ CENTER  
2600 BLAIRSTONE ROAD  
TALLAHASSEE, FLORIDA 32399-2400

RICK SCOTT  
GOVERNOR

CARLOS LOPEZ-CANTERA  
LT. GOVERNOR

HERSCHEL T. VINYARD JR.  
SECRETARY

---

## Electronic Submission Application for an Individual or Conceptual Permit

You have successfully submitted an Application for an Individual or Conceptual Permit in accordance with Part IV of Chapter 62-330 F.A.C.. Your request was received on **TBD**.

Below is a copy of the details of your request for your records.

### Facility Information

**Site Name:** OCUDEASTERN REGIONAL WWTF (ERP)  
**Address Line 1:** 1621 S Alafaya Trl  
**Address Line 2:**  
**City/State/Zip Code:** Orlando, FL 32828 8702

### Mailing Address

**Address Line 1:** 1621 S Alafaya Trl  
**Address Line 2:**  
**City/State/Zip Code:** Orlando, FL 32828 8702

### Applicant

**Company Name:** Orange County Utilities  
**Title:** Water Reclamation Division - Manager  
**Name:** Larry Tunnell  
**Address Line 1:** 9150 Curry Ford Rd  
**Address Line 2:**  
**City/State/Zip Code:** Orlando, FL 32825 7600  
**Phone Number:** (407) 254-9721  
**Extension:**  
**Cell Number:**  
**Fax Number:**  
**E-mail Address:** larry.tunnel@ocfl.net

### Property Owner

**Company Name:** Orange County Utilities  
**Title:** Water Reclamation Division - Manager  
**Name:** Larry Tunnell  
**Address Line 1:** 9150 Curry Ford Rd  
**Address Line 2:**  
**City/State/Zip Code:** Orlando, FL 32825 7600  
**Phone Number:** (407) 254-9721  
**Extension:**  
**Cell Number:**  
**Fax Number:**  
**E-mail Address:** larry.tunnel@ocfl.net

### **Consultant**

**Name:** Bill Marshall  
**Address Line 1:** 150 N Orange Ave  
**Address Line 2:**  
**City/State/Zip Code:** Orlando, FL 32801 2303  
**Phone Number:** (407) 513-8233  
**Extension:**  
**Cell Number:**  
**Fax Number:**  
**E-mail Address:** bill.marshall@aecom.com

### **Project Information**

**Tax Parcel Identification Number(s):** 02-23-31-0000-00-002  
**Anticipated Commencement Date:** 01/01/2015  
**Anticipated Completion Date:** 01/01/2018  
**Project Name (including Phase):** EWRF Phase V Improvements

This project **IS NOT** part of a larger plan of development or sale.

**Project or project phase area (in acres):** 14.5

**Impervious or semi-impervious area (excluding wetlands and other surface waters):** 1.8

**In:** ACRES

**Volume of water the system is capable of impounding (in acre-feet):** 0.5

**The total number of proposed new (not existing) in-water boat slips (including mooring areas and boat lifts):** 0

**Total area of work (dredging, filling, construction, alteration, or removal) in, on, or over wetlands or other surface waters:** 0

**In:** SQ FT

**Total volume of material to be dredged (in cubic yards):** 0

**Total volume of material to be filled (in cubic yards):** 0

**Pre-Application Meetings:**

Agency	Date	Location	Attendees
FDEP	2/12/2012	FDEP	Deb Laisure, Bill Marshall, Mike Howe
FDEP	7/22/2008	FDEP	Deb L, Leo A, Bill M, Tim Madhanagopal & Alan Gay

**Project Description:**

The Project is an process treatment capacity expansion to Orange County Utilities existing Easter Water Reclamation Facility (EWRF). It will expand the treatment capacity of the EWRF from 19 to 24 MGD AADF. It includes several new tanks, Buildings and civil site enhancements. The construction cost is approximately \$60,000,000 and will take over three years to complete. It is comprised of two Bid Packages; Bid Package A (The Phase V Improvements) and Bid Package B (The Centrifuge Dewatering Improvements). It will include a new dry retention storm water treatment facility.

**Waterbodies Information:**

The system drains into a natural wetlands upstream of the constructed EWRF Wetlands Effluent Treatment system. This system then ultimately discharges into an un-named creek along Alafaya Trail which is part of the Big Econlockhatchee River system.

**DEP Permits:**

Project Name	Permit/Application Number	Expiration Date
TIME EXTENSION ON SPEC COND	0254537-006-EM	07/14/2016
MINOR MOD SPEC COND	0254537-005-EM	03/31/2011
OCUD EASTERN REGIONAL WRF	0254537-004-EM	02/11/2013
OCUD/EASTERN	0254537-003-EM	03/31/2011
OCUD/EASTERN EXPANSION	0254537-002-SI	02/28/2011
OCUD/EASTERN	0254537-001-SI	02/28/2011

**Other Permits:****Attachments:**

**File Description:** SWERP Supporting Document - Centrifuge Geotech

**File Name:** EWRFCentrifuge-Geotech\_H1125048.pdf

**File Hash:** 598e3625c4d0cdec64913bce4c014511a538d9ec8c3384f8c0c2b9f8c82099db

**File Description:** SWERP Supporting Document - Phase V Geotech

**File Name:** EWRF5Geotech\_H1115424.pdf

**File Hash:** b5b9e433579a2499c5f769ac5a88a1ce19054e2548951aa7cba1d8fe32540c4d

**File Description:** SWERP Supporting Document - Wildlife TM

**File Name:** EWRF-Wildlife-Memo\_WDM-Signed.pdf

**File Hash:** 1b13c68ba5afd1df818dedcf2dad628f434c64f79b7840a8acf1f42e022afd0e

**File Description:** SWERP Supporting Document - Hypochlorite Dwgs

**File Name:** EWRF\_SodiumHypochloriteImp\_Reiss.pdf

**File Hash:** 9e1569a78e51b6a96ec058b2b45a91e4889ff31e14be48d73399906d75894bae

**File Description:** SWERP Supporting Document - Generator Stor. Dwgs

**File Name:** EWRF\_GeneratorConversion\_Reiss.pdf

**File Hash:** 3261fa2139b9a98e9123347696da414e7295d7ae9e7f26d7100b1dd22d770e3a

**File Description:** SWERP Supporting Document - Centrifuge Drawings

**File Name:** EWRF\_Centrifuge\_Construction\_ERP\_WDMSigned.pdf

**File Hash:** 711d9b095903af592e506946c98ff7ddf7b16ee362fbef3313ce680e4109658e

**File Description:** SWERP Supporting Document - Phase V Drawings

**File Name:** EWRF Ph V\_Construction Plans\_ERP-WDMSigned.pdf

**File Hash:** a50a28cf640f9085f2a8cbfb29fbf66fce770bfd2bd4ffb2adf6779491f0f51

**File Description:** SWERP Supporting Document - Drainage Analysis TM

**File Name:** EWRF\_PhaseV\_StormwaterTM.pdf

**File Hash:** 69e208c6177918bb1381a91012fa7c9d9da9bfd72e3044b9b76c3d48b3e030d6

**File Description:** SWERP Supporting Document - Centrifuge Plans

**File Name:** +.pdf

**File Hash:** 4b1134d1511522e864cecc0b6fbd4faba7d99169ab46787d42ad95c827ed68be

**File Description:** SWERP Supporting Document - Phase V Plans

**File Name:** Figure2\_SoilsMap.pdf

**File Hash:** deee8f4abec70cac06624e99fb4b71a94a83846e7d57cfbc1483e4262b81c5e8

**File Description:** SWERP Supporting Document - Drainage Analysis TM

**File Name:** +.pdf

**File Hash:** 4b1134d1511522e864cecc0b6fbd4faba7d99169ab46787d42ad95c827ed68be

**File Description:** SWERP Supporting Document - Endangered TM

**File Name:** Figure2\_SoilsMap.pdf

**File Hash:** deee8f4abec70cac06624e99fb4b71a94a83846e7d57cfbc1483e4262b81c5e8

**File Description:** SWERP Supporting Document - Gentrifuge Geotech  
**File Name:** EWRFCentrifuge-Geotech\_H1125048.pdf  
**File Hash:** 598e3625c4d0cdec64913bce4c014511a538d9ec8c3384f8c0c2b9f8c82099db

**File Description:** SWERP Supporting Document - Centrifuge Site Plan  
**File Name:** EWRF-CENTRIFUGES\_SitePlans.pdf  
**File Hash:** 1fbedfbc166e34091a72b265f605b26999c52db561d0ea8909cec76b3fa8291e

**File Description:** SWERP Supporting Document - Phase V Geotech  
**File Name:** EWRF5Geotech\_H1115424.pdf  
**File Hash:** b5b9e433579a2499c5f769ac5a88a1ce19054e2548951aa7cba1d8fe32540c4d

**File Description:** SWERP Supporting Document - Phase V Site Plans  
**File Name:** EWRF-5\_SitePlans.pdf  
**File Hash:** 97e1638a895fed2996256bab1738138a6d50f493361858aa63bfca1f898ca221

**Notification Submitted By**

**Name:** Bill Marshall  
**Phone Number:** (407) 513-8233  
**E-mail Address:** bill.marshall@aecom.com

All information submitted was certified true, accurate, and correct to the best of the knowledge of the person whose name appears above.

If you have any questions or concerns about the information contained in this report, please contact FDEP Service Desk at (850) 245-7555 or by e-mail at ServiceDesk@dep.state.fl.us.

**THIS PAGE LEFT BLANK INTENTIONALLY**

**Building Permit B13903742 application submitted. Approved permit will be inserted**



**THIS PAGE LEFT BLANK INTENTIONALLY**

**Orange County Concurrency Deminimus Permit application submitted. Approved permit will be inserted**

**THIS PAGE LEFT BLANK INTENTIONALLY**

## **Appendix D**

### **List of Approved Products**

**THIS PAGE LEFT BLANK INTENTIONALLY**

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Air Release	ARV Enclosure	<b>All ARV above ground enclosures shall be vented with tamper proof locking device</b>						
		Water Plus Polyethylene Enclosure	131632 H30-B 171730 H40-B	Blue 44" Tall Blue 30" Tall	131632 H30-P 171730 H40-P	Pantone 44" Pantone 30"	131632 H30-G 171730 H40-G	Green 44" Tall Green 30" Tall
		Hot Box Vent Guard	AVG2036 Encl GP3232 Base	Blue 36" Tall	AVG2036 Encl GP3232 Base	Pantone 36" Tall	AVG2036 Encl GP3232 Base	Green 36" Tall
		Fiberglass Enclosure	AVG2041 Encl GP3232 Base	Blue 41" Tall	AVG2041 Encl GP3232 Base	Pantone 41" Tall	AVG2041 Encl GP3232 Base	Green 41" Tall
		Safety-Guard/Hydro Guard	15100 Encl	Blue 34" Tall	15100 Encl	Pantone 34" Tall	15100 Encl	Green 34" Tall
	Air Release Valves	<b>Air Release Valves shall be Combination Type, 316 SS</b>						
		ARI	D-040SS	Combination	D-040SS	Combination	D-020 (SS)	Combination
		H-TEC	NA	NA	NA	NA	986 (316SS)	Combination
	ARV Vault	<b>Air Release Valve Frame and Cover</b>						
		US Foundry	NA	NA	NA	NA	USF 7665-HH-HJ	
Blow Off	Auto Blow Off	<b>Automatic Blow Off Valve</b>						
		Hydro Guard	HG-1 Standard Unit	Automatic	NA	NA	NA	NA
	Blow Off Valve	<b>Blow Off Valve - Fits standard 5-1/4 inch Valve Box</b>						
		Kupferle Foundry Co	Truflo Series TF #550		Truflo Series TF #550		NA	NA
Casing Seals / Spacers	Casing End Seals	<b>Casing End Seals. Annular space between pipe and steel casing shall be brick and mortar with end seals to secure ends.</b>						
		Advance Products	Model AC and AW		Model AC and AW		Model AC and AW	
		BWM Company	Model WR and PO		Model WR and PO		Model WR and PO	
		Cascade Water Works	Model CCES		Model CCES		Model CCES	
		CCI Pipeline	Model ESW and ESC		Model ESW and ESC		Model ESW and ESC	
		Pipeline Seal & Insulator, Inc (PSI)	Model C and W		Model C and W		Model C and W	
		Power Seal	Model 4810ES		Model 4810ES		Model 4810ES	

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Casing Seals / Spacers	Casing spacer	<b>Casing spacers shall be a min. 8-inches wide for pipe 12" Dia or less or min. 12-inches wide for pipe 16 or greater , shall have a minimum 14 gauge 304 stainless steel shell/band, minimum 10 gauge 304 reinforced risers; minimum thickness of 0.090 EPDM or PVC interior liners, glass reinforces polymer or ultra high molecular weight polyethylene and 304 stainless bolts, nuts and washers.</b>						
		Advance Products	SSI8 / SSI12		SSI8 / SSI12		SSI8 / SSI12	
		BWM Company	BWM-SS-8 / SS-12		BWM-SS-8 / SS-12		BWM-SS-8 / SS-12	
		Cascade Water Works	Series CCS 8" / 12"		Series CCS 8" / 12"		Series CCS 8" / 12"	
		CCI Pipeline	Model CCS8 / CSS12		Model CCS8 / CSS12		Model CCS8 / CSS12	
		Pipeline Seal & Insulator, Inc (PSI)	Series S8G-2 / S12G-2		Series S8G-2 / S12G-2		Series S8G-2 / S12G-2	
Coatings	Exterior Coatings for Exposed Metal Assets	<b>Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 1 Zinc / Urethane / Fluoropolymer application and color code per Section 3119 Coatings &amp; Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.</b>						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils
		Tnemec	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
	Zinc Series 90-97		2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	
	Typosy Series 27WB		4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils	
	EnduraShield Series73		2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	
	Exterior Coatings for Exposed Metal Assets	<b>Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 2 Zinc / Epoxy / Urethane application and color code per Section 3119 Coatings &amp; Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.</b>						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
		Tnemec	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils
Typosy Series 27WB			4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils	
Hi-Build Epoxoline II Series N69			4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	
EnduraShield Series73			2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	
PPG / Ameron	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils		
	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils		
	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils		



Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Fittings	Fittings	<b>Ductile Iron Fittings C153 SSB / C110 FLG: (Water &amp; Reclaimed Water fittings shall cement lined or holiday free fusion bonded epoxy lined) (Wastewater fittings interior shall be Protecto 401 and holiday free)</b>						
		American	30" & up	FBE / Cement	30" & up	FBE / Cement	30" & up	Protecto 401
		Sigma		FBE / Cement		FBE / Cement		Protecto 401
		Star		FBE / Cement		FBE / Cement		Protecto 401
		Tyler Union & Clow		FBE / Cement		FBE / Cement		Protecto 401
Flow Meter	Flow Meter	<b>Flow Meters With Replaceable Sensors</b>						
		EMCO	NA	NA	NA	NA	Unimag 4411E	
Hydrants	Hydrants	<b>Hydrants Shall open left, 1-1/2 Pentagon operating nut, NST hose &amp; pumper thread, rotate 360 degrees, closed drains, epoxy on shoe in &amp; out and 304 SS nuts &amp; bolts below ground.</b>						
		American Flow Control	B-84-B (6 inch)		NA	NA	NA	NA
		Clow	Medallion 2545		NA	NA	NA	NA
		Mueller	Super Centurion 250		NA	NA	NA	NA
Joint Restraints	Ductile iron pipe MJ Restraints	<b>Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain ductile iron pipe to mechanical joint fittings, pipe and appurtenances.</b>						
		EBAA Iron Inc	Megalug Series 1100		Megalug Series 1100		Megalug Series 1100	
		Ford / Uni-Flange	UFR-1400		UFR-1400		UFR-1400	
		Sigma	OneLok Series SLD/SLDE		OneLok Series SLD/SLDE		OneLok Series SLD/SLDE	
		Smith Blair	Cam Lok Series 111		Cam Lok Series 111		Cam Lok Series 111	
		Star	Star Grip Series 3000		Star Grip Series 3000		Star Grip Series 3000	
		Tyler Union	TufGrip Series TLD		TufGrip Series TLD		TufGrip Series TLD	
	DIP Bell Joint Restraints (4"-12") (New & Existing)	<b>Bell Joint Restraints for Ductile Iron Pipe (4"-12") (New &amp; Existing) - All restraints split serrated on bell and spigot ends. Pipe 16" and greater shall have restraint gaskets or locking bells. (Wastewater only for restraint of existing DIP FM)</b>						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390C		Uni-Flange Series 1390C		Uni-Flange Series 1390C	
		Sigma	PV-Lok Series PWP-C		PV-Lok Series PWP-C		PV-Lok Series PWP-C	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	StarGrip Series 3100S		StarGrip Series 3100S		StarGrip Series 3100S	
DIP Bell Joint Restraints (16" & Greater)	<b>Ductile Iron Pipe Bell Joint Restraints for Ductile Iron Pipe (16" &amp; Greater) - All restraints shall have a split back-up ring for the bell and a serrated or wedge action gland for the spigot end. New installation for water &amp; reclaimed water piping 16" and greater shall have restraint gaskets or locking bells.</b>							
	EBAA Iron Inc	Series 1100HD	Existing Only	Series 1100HD	Existing Only	Series 1100HD	Existing Only	
	Sigma	Series SSLDH	Existing Only	Series SSLDH	Existing Only	Series SSLDH	Existing Only	
	Star	Series 3100S	Existing Only	Series 3100S	Existing Only	Series 3100S	Existing Only	



Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Joint Restraints	Ductile iron pipe Bell Joint Restraint Gaskets and Locking Bell (4" & Above)	<b>Bell Joint Restraint Gaskets and Locking Bell (4" &amp; Above) Stainless Steel locking wedges built into the gasket-rubber. ANSI/AWWA C111/A21.11 Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe. Ductile Iron Bell Joint Restraint for Push-On Pipe- Locking bell joint system that prevents joint separation and allows for joint deflection. Bells shall be painted red to verify restrained gasket.</b>						
		American	Fast Grip Gasket	Gasket	Fast Grip Gasket	Gasket	NA	NA
			Flex-Ring Joint	Bell Lock	Flex-Ring Joint	Bell Lock	NA	NA
			Lok-Ring Joint	Bell Lock	Lok-Ring Joint	Bell Lock	NA	NA
		Griffin	Talon RJ Gasket	Gasket	Talon RJ Gasket	Gasket	NA	NA
			Snap-Lok	Bell Lock	Snap-Lok	Bell Lock	NA	NA
		McWane Inc. DI Pipe Group	Sure Stop 350 Gasket	Gasket	Sure Stop 350 Gasket	Gasket	NA	NA
			Thrust-Lock	Bell Lock	Thrust-Lock	Bell Lock	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			Super-Lock	Bell Lock	Super-Lock	Bell Lock	NA	NA
		US Pipe	Field Lok 350 Gasket	Gasket	Field Lok 350 Gasket	Gasket	NA	NA
			Field Lok Gasket	Gasket	Field Lok Gasket	Gasket	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
	HP Lok Restraint Joint		Bell Lock	HP Lok Restraint Joint	Bell Lock	NA	NA	
	SS to DIP Transition Restraint	<b>SS to DIP Transition Restraint - Flanged stainless steel pipe from Wetwell to Valve box restrained joint transition (epoxy coated, SS hardware) Flg x PE RJ.</b>						
		EBAA Iron Inc	NA	NA	NA	NA	Megaflange 2100	
		Sigma	NA	NA	NA	NA	SigmaFlange with One Lock SLDE	
		Smith Blair	NA	NA	NA	NA	911 Flange - Lock Restrained FCA	
	PVC Pipe MJ Restraints	<b>Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain PVC pipe to mechanical joint fittings, and appurtenances.</b>						
		EBAA Iron Inc	Mega-lug Series 2000PV		Mega-lug Series 2000PV		Mega-lug Series 2000PV	
			NA	NA	NA	NA	Megalug Series 2200 (42"-48")	
		Ford / Uni-Flange	UFR 1500 Series		UFR 1500 Series		UFR 1500 Series	
		Sigma	One Lok Series SLC/SLCE		One Lok Series SLC/SLCE		One Lok Series SLC/SLCE	
		Smith Blair	Cam Lok Series 120		Cam Lok Series 120		Cam Lok Series 120	
		Star	Star Grip Series 4000		Star Grip Series 4000		Star Grip Series 4000	
	Tyler Union	TufGrip Series TLP		TufGrip Series TLP		TufGrip Series TLP		
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	<b>PVC Bell Joint Restraints: PVC pipe Split Serrated on Bell End and Spigot End. (4" - 12") (New &amp; Existing)</b>						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390		Uni-Flange Series 1390		Uni-Flange Series 1390	
		Sigma	PV-Lok Series PWP		PV-Lok Series PWP		PV-Lok Series PWP	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	Series 1100C		Series 1100C		Series 1100C	
		Tyler Union	TufGrip 300C		TufGrip 300C		TufGrip 300C	

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Joint Restraints	PVC Bell Joint Restraints (16" & Greater)	<b>PVC Bell Joint Restraints: (16" &amp; Greater) PVC pipe Split Serrated on Bell End and Spigot End. Water &amp; Reclaimed Water Existing pipe only. Wastewater shall be new and existing pipe.</b>						
		Ford / Uni-Flange	Series 1390	Existing Only	Series 1390	Existing Only	Series 1390	
		JCM	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	
		Sigma	PV-Lok PWP	Existing Only	PV-Lok PWP	Existing Only	PV-Lok PWP	
		Smith Blair	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	
		Star	Series 1100C	Existing Only	Series 1100C	Existing Only	Series 1100C	
Pipe	PVC C900 DR 18 Bell & Spigot (4" - 12")	<b>C900 Bell &amp; Spigot PVC Pipe: 4 to 12-inch - AWWA C-900, Minimum DR18 for Water, Reclaimed and Wastewater. DR14 for Fire Lines. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.</b>						
		Certaiteed 4" to 12"	Certa-Lok C900/RJ	Blue	Certa-Lok C900/RJ	Pantone Purple	Certa-Lok C900/RJ	Green
		Diamond Plastics Corp	C-900	Blue	C-900	Pantone Purple	Diamond C900	Green
		Ipex Inc	C-900 Blue Brute	Blue	C-900	Pantone Purple	C900 Blue Brute	Green
		JM Eagle	C-900	Blue	C-900	Pantone Purple	C-900	Green
		National Pipe & Plastics Inc	C-900 Dura- Blue	Blue	C-900	Pantone Purple	C-900 Pipe	Green
		North American Pipe Corp (NAPCO)	C-900	Blue	C-900	Pantone Purple	C-900	Green
		Sanderson Pipe Corp	C-900	Blue	C-900	Pantone Purple	C-900	Green
Pipe	PVC C905 DR 18 Bell & Spigot 16" and Larger	<b>C905 Bell &amp; Spigot PVC Pipe 16" and Larger: AWWA C-905, Minimum DR18 for all Force Mains up to 24". Minimum DR21/DR25 for 30" and greater. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.</b>						
		Certaiteed 16"	NA	NA	NA	NA	Certa-Lok C905/RJ	NA
		Diamond Plastics Corp	NA	NA	NA	NA	Trans-21 DR18	Green
		Ipex Inc	NA	NA	NA	NA	IPEX Centurion	Green
		JM Eagle	NA	NA	NA	NA	C905 Big Blue	Green
		National Pipe & Plastics Inc	NA	NA	NA	NA	C905	Green
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	C905 Big Blue	Green
Pipe	HDPE C906 DR11	<b>HDPE Pipe DR11 AWWA C906 shall be Ductile Iron Pipe Size, PE 3408/3608/4710 DIPS manufactured in accordance with ASTM F-714 and listed with NSF. Pipe shall be marked in accordance with either AWWA C901,AWWA C906. Compression type connections are not acceptable in new installations. Pipe joints shall be butt fusion or electro-fusion with flange or adapter. All HDPE shall be color coded to the Utility. Color identifications are in accordance with the APWA/ULCC Uniform Color Code. Manufacturers shall be members in good standing with PPI to maintain approval status.</b>						
		JM Eagle	HDPE	DR11 Blue	HDPE	DR11 Pantone	HDPE	DR11Green
		Performance Pipe(Chevron)	Driscoplex 4000	DR11 Blue	Driscoplex 4000	DR11 Pantone	Driscoplex 4300	DR11 Green
		PolyPipe, Inc.	EHMW Poly Pipe	DR11 Blue	EHMW	DR11 Pantone	EHMW	DR11Green



Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Pipe	Ductile Iron Pipe	<b>Ductile iron/Cast iron: (4" to 12" = Class 350, 16" to 24" - Class 250, 30" to 64" = Class 200). Water and Reclaimed water shall be cement lined. Wastewater Piping shall be Protecto 401 and Holiday Free. Exterior coatings as specified. Wastewater DIP piping shall be for pump station piping only. Manufacturers shall be members in good standing with DIPRA to maintain approval status.</b>						
		American	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		Griffin	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		McWane Inc. DI Pipe Group	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		US Pipe	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
Sample	Sample Station	<b>Sample Stations - Bacteriological Sample Station with built in flush system, all internal piping to be 2", brass and includes lockable green enclosures.</b>						
		Safety-Guard	SG-BSS-05 pedestal #77	green enclosure	NA	NA	NA	NA
		Water Plus Corp	Model 5000	green	NA	NA	NA	NA
Services	Brass Service Saddles	<b>Brass Service Saddles for 1" &amp; 2" water &amp; reclaimed water services on 4" through 12" Mains - Service saddles can be hinge or bolt controlled OD saddles to be used on C-900 and existing IPS OD PVC pipe.</b>						
		Ford	Series S-70, S-90	4"-12"	Series S-70, S-90	4"-12"	NA	NA
		AY McDonald	Model 3891 / 3895,3801 / 3805	4"-12"	Model 3891 / 3895,3801 / 3805	4"-12"	NA	NA
		Mueller	Series S-13000/H-13000	4"-12"	Series S-13000/H-13000	4"-12"	NA	NA
Services	Service Saddles	<b>Service Saddles for 1" (CC) &amp; 2" (Iron pipe threads) Water &amp; Reclaimed Water services on mains greater than 12". Service saddles for 2" taps (iron pipe threads) on 4" mains and greater for Waste Water. : Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on C-900 / C905 or DI for all 1-in and -2in taps on pipes over 12in.</b>						
		Ford	Series FC202	16" & greater	Series FC202	16" & greater	Series FC202	4" & greater
		JCM	Series 406	16" & greater	Series 406	16" & greater	Series 406	4" & greater
		Mueller	DR2S	16" & greater	DR2S	16" & greater	DR2S	4" & greater
		Romac	Series 202NS	16" & greater	Series 202NS	16" & greater	Series 202NS	4" & greater
		Smith Blair	Series 317	16" & greater	Series 317	16" & greater	Series 317	4" & greater
Services	Service Saddles for HDPE	<b>Service Saddles for 1" (CC) &amp; 2" (Iron Pipe threads) Water and Reclaimed Water Services: Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on HDPE for all 1-in and -2in taps. Taps to HDPE pipe shall be approved on a case by case basis.</b>						
		Ford	Series FCP202		Series FCP202		Series FCP202	
		Romac	Series 202N-H		Series 202N-H		Series 202N-H	
		Smith Blair	Series 317-1 for HDPE		Series 317-1 for HDPE		Series 317-1 for HDPE	
Services	Corporation Stops Ball Type	<b>Corporation Stops Ball Type (1-inch with AWWA taper C threads only/pack joint outlet for CTS) 2" Corporation Stop Ball Type shall be 2" MIP X FIP threads.</b>						
		Ford	FB1000, FB1700-7		FB1000, FB1700-7		FB1700-7	2" ARV
		AY McDonald	4701B-22, 3149B2		4701B-22, 3149B2		3149B2	2" ARV
		Mueller	P25008, B-20046		P25008, B-20046		B-20046	2" ARV

D103

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	Comments	
Services	Curb Stops	<b>Curb Stops - Straight Valves: Ball type compression 2" cts O.D. tubing by 2" FIP</b>							
		Ford	B41-777W		B41-777W		NA	NA	
		AY McDonald	6102W-22		6102W-22		NA	NA	
		Mueller	P25172		P25172		NA	NA	
	Curb Stops	<b>Curb Stops - Straight Valves: ball type compression x compression</b>							
		Ford	B44-444W		B44-444W		NA	NA	
		AY McDonald	6100W-22		6100W-22		NA	NA	
		Mueller	P25146		P25146		NA	NA	
	PE tubing	<b>Polyethylene tubing: AWWA C901. UV protection (SDR-9) 1-inch and 2-inch only. PE 3408 / PE 4710</b>							
		Charter Plastics	Blue Ice		Lav Ice		NA	NA	
		Endot	Endopure Blue		Endocore Lavender		NA	NA	
		JM Eagle	Pure-Core		NA	NA	NA	NA	
Line Stops	<b>Line Stops</b>								
	JCM								
	Romac								
	Smith Blair								
Tapping Sleeves and Valves	Tapping Sleeves	<b>Tapping Sleeves: (Mechanical joint for taps on cast iron, ductile iron, PVC &amp; AC pipe, including size on size) with stainless steel nuts and bolts.</b>							
		American Flow Control	Series 2800		Series 2800		Series 2800		
			Series 1004		Series 1004		Series 1004		
		Clow	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC	
			Series F-5207	A/C Pipe	Series F-5207	A/C Pipe	Series F-5207	A/C Pipe	
		JCM	Series 414	FBE	Series 414	FBE	Series 414	FBE	
		Mueller	Series H-615	DIP/PVC	Series H-615	DIP/PVC	Series H-615	DIP/PVC	
Series H-619	A/C Pipe		Series H-619	A/C Pipe	Series H-619	A/C Pipe			
Smith Blair	Style 623	FBE	Style 623	FBE	Style 623	FBE			
Tapping Valves: 12" and smaller	<b>Tapping Valves: 12" and smaller - Tapping Valves shall be furnished with an alignment lip and installed in the vertical position for Water and Reclaim Water. Wastewater shall be installed horizontally and abandoned in the open position. Tapping valves shall be resilient seated only and meet the requirements of AWWA C509 or C515</b>								
	American Flow Control	Series 2500	Alignment Lip	Series 2500	Alignment Lip	Series 2500	Alignment Lip		
	Clow	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip		
	Mueller	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip		



Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Tapping Sleeves and Valves	Tapping Valves: 16" and Larger	<b>Tapping Valves: 16" and Larger - Tapping valves shall be furnished with an alignment lip and be installed in the vertical position for Water and Reclaimed Water. No tapping valve shall be installed horizontally for Water and Reclaim Water unless approved by the engineer. Tapping Valves 16" and larger AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a spur gear actuator unless noted by the engineer. All tapping valves above 24" shall be furnished with NPT pipe plugs for flushing the tracks when valves are installed horizontally. Tapping valves for Wastewater shall be installed horizontally and abandoned in open position.</b>						
		American Flow Control	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port
		Clow	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port
		Mueller	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port
Valves	Butterfly Valve 42" and Above	<b>Butterfly Valves 42" and above. AWWA C504. Actuators input torques based on 150 psi valve pressure and 16 fps velocity with a maximum input of 80 ft-lb on 2" nuts and shall withstand 250 ft-lbs. Valve seats shall be leak-tight in both directions at 150 psi.</b>						
		Clow	Style #1450		Style #1450		NA	NA
		Dezurik	BAW		BAW		NA	NA
		Mueller / Pratt	LINSEAL III / Groundhog		LINSEAL III / Groundhog		NA	NA
Valves	Check Valves	<b>Valves (Check) 4-inch and Larger (8 mil epoxy lined)</b>						
		American Flow Control	NA		NA		Series 600 or 50 line	
		Clow / M&H / Kennedy	NA		NA		106	
		Mueller	NA		NA		Series 2600	
Valves	Gate Valves 4" - 12"	<b>Gate Valves 12" and smaller - resilient seated only AWWA C509 or C515. Valve seat shall be leak-tight in both directions at 150 psi.</b>						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
		Mueller	Series A-2360		Series A-2360		NA	NA
Valves	Gate Valves (Vertical) 16" and Up	<b>Gate Valves 16" and larger (Vertical Installation) AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a gear actuator unless noted by the engineer. Valve seat shall be leak-tight in both directions at 150 psi.</b>						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
		Mueller	Series A-2361		Series A-2361		NA	NA

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater			
			Model #	Comments	Model #	Comments	Model #	Comments		
Valves	Plug Valves	<b>Plug Valves - Bi-directional, MJ &amp; Flanged (min. 8mil fusion bonded epoxy with stainless steel bolts), gear operator to be sized for rated pressure of the valve. Valves 4"-20" shall be 80% Full Port and valves 24" and greater shall be minimum of 70% full port. Valve shall be factory tested to minimum 100 PSI in both directions.</b>								
		Clow	NA	NA	NA	NA	F-5412 FLG	4" & up		
			NA	NA	NA	NA	F-5413 MJ	4" & up		
		Dezurik	NA	NA	NA	NA	Series PEF or PEC	4" & up		
		Millikan / Pratt	NA	NA	NA	NA	Eccentric / Ballcentric	4" & up		
	Val-Matic	NA	NA	NA	NA	5600 or 5800 (FLG)	4" & up			
		NA	NA	NA	NA	5700 or 5900 (MJ)	4" & up			
Valve Boxes	Valve Boxes with Locking Lids (Cast Iron)	<b>Two piece standard screw type Heavy Duty Valve Boxes with Locking Lids (Cast Iron) and type of service cast in heavy duty traffic lid (H20 loading) ASTM A48</b>								
		Bingham/Taylor	Series 4905	Box	NA	NA	Series 4905	Box		
			4905-X	Extension	NA	NA	4905-X	Extension		
			4904-L	Blue Water Locking Lid	NA	NA	4904-L	Green Sewer locking Lid		
		Sigma	Series VB 261X-267X	Box	VB-25031LK-VB-2612	Box	Series VB 261X-267X	Box		
			VB 6302	Extension	VB-6302	Extension	VB 6302	Extension		
			VB 4650W	Blue Water Locking Lid	VB2503LK	Purple Square Locking Lid	VB 4650S	Green Sewer locking Lid		
		Star	Series VB-0002	Box	NA	NA	Series VB-0002	Box		
			VBEX 12-24S	Extension	NA	NA	VBEX 12-24S	Extension		
			VBLIDLOCK	Blue Water Locking Lid	NA	NA	VBLIDLOCK	Green Sewer locking Lid		
		Tyler Union	Series 6850	Box	NA	NA	Series 6850	Box		
			58, 59, 60	Extension	NA	NA	58, 59, 60	Extension		
			Locking Lid	Blue Water Locking Lid	NA	NA	Locking Lid	Green Sewer locking Lid		
		Valve Box	Valve Box	<b>For mains equal to, or greater than, 16" diameter or equal to greater than 6' feet deep</b>						
				American Flow Control	# 2A - 9A Retrofit Valve Box Insert	Fit inside std valve boxes	NA		2A - 9A Retrofit Valve Box Insert	Green Sewer locking Lid
Mueller Company	MVB050C thru MVB130C with Extension Stem			Blue Water Locking Lid	MVB050CR thru MVB130CR with Extension Stem	Purple Square Locking Reclaim Lid	MVB050C thru MVB130C with Extension Stem	Green Sewer locking Lid		
		MVB875 Guide Plate		MVB875 Guide Plate		MVB875 Guide Plate				

