

**SECTION 02784**  
**CHAIN LINK FENCES AND GATES**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: This section specifies black PVC coated chain-link fence, nominally 8-foot high with 3 strands of barbed wire at a 45-degree angle, complete with gates to be constructed around the area indicated on the Drawings.

1.02 QUALITY ASSURANCE

- A. Chain link fences and gates shall be constructed in accordance with specified standards, as well as all pertinent codes and regulations. Where provisions of pertinent codes conflict with the specifications, the more stringent provisions shall govern.
- B. Chain link fences and gates shall be manufactured by established, reputable manufacturers that have been engaged in the manufacture of chain link fencing for at least 10-years.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. The Contractor shall submit layout drawings of all fence and gate installations along with details and manufacturer's literature of all fence and gate materials in the Project.
- C. The Contractor shall submit all motor data, connection diagrams, wiring diagrams, and O&M instructions for all gate operators in the Project.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

## 2.02 MATERIALS

- A. Fabric: The fabric shall be aluminum coated steel chain link, 96-inches high, No. 9-gauge wire woven in a 2-inch mesh. The fabric shall conform to the requirements of ASTM Designation A392. The aluminum coating shall be a minimum of 0.40-ounces per square foot of wire surface for No. 9-gauge fabric. The fabric shall have a minimum tensile strength of 75,000-psi. The weight of the coating shall be determined by the strip test as defined in ASTM Designation A428. The fabric shall be coated with an ultra violet stable black PVC coating which meets ASTM standards F688 Class I.
- B. Post and Other Appurtenances: All posts and other appurtenances used in the construction of this fence shall be hot dipped galvanized with a minimum of 1.8-ounces per square foot of surface. Pipe sections shall conform to the requirements of ASTM Designation A120. All posts, rails, and fittings shall be coated with an ultra violet stable black PVC coating which meets ASTM standards F688 Class I.
- C. Sizes of Posts, Gate Frames, and Rails:

COMPONENT	DIMENSIONS	
	Nominal Diameter	NPS Pipe Schedule
1. End, corner & pull posts	3-inch	40
2. Gateposts (one leaf width 8-feet or less)	3-inch	40
3. Intermediate posts	2-3/8-inch	40
4. Gate Frames	1-5/8-inch	40
5. Braces	1-5/8-inch	40
6. Top Rails	1-5/8-inch	20

### D. Gates

1. Swing Gates: Gates shall be complete with latches, stops, keepers, and hinges. Gate frames shall be constructed of round tubular members continuously welded at all corners or assembled with fittings. Welds shall be painted with aluminum or zinc based paint prior to application of PVC coating. Gate filler shall be of the same fabric as specified for the fence and shall be attached securely to the gate frame with No. 9 tie wires at intervals not exceeding 12-inches. Hinges shall be of adequate strength for the gate and with large bearing surfaces for clamping in position. The hinges shall not twist or turn under the action of the gate. The gates shall be easily operable by one person. Latches, stops, and keepers for all gates, along with 1-inch stainless steel chain and padlock, shall be provided.
2. Gate padlocks shall be the County standard, case brass, shackle-case hardened steel, 1-inch links with 12-inch chain, 606 finish and keyed alike when more than one.

- E. Top Rail: The top rail shall be provided with couplings approximately every 20-feet. Couplings are to be the outside sleeve type, at least 6-inches long.

- F. Barbed wire shall be 2-strand, 12 1/2 –gauge wire with 14 gauge, 4-point barbs at 5 inches center. Barbed wire shall conform to ASTM A-121, zinc coated, and black PVC coated.
- G. Concrete: Concrete shall have a minimum compressive strength of 2,500-psi at 28-days.
- H. Hardware: Miscellaneous hardware shall be of steel, malleable iron or ductile iron of standard design and conform to the requirements of the Chain Link Fence Manufacturer's Institute. All parts shall be galvanized except ties and clips may be aluminum.

## **PART 3 - EXECUTION**

### **3.01 ARRANGEMENT**

- A. Posts: Posts shall be uniformly spaced, not to exceed 10-feet on centers. Intermediate posts shall have waterproof tops, which have integrally cast openings through which the top rails shall pass. Terminal posts shall consist of end, corner, and pull posts.
- B. Braces: Braces shall be provided at each gate, corner, pull, and end post.
- C. Top Rails: The top rails shall pass through the line post tops and form a continuous brace from end to end of each stretch of fence. The top rail shall be securely fastened to the terminal posts by heavy pressed steel brace bands and malleable end connections.
- D. Bottom Tension Wire: The bottom tension wire shall be No. 7-gauge aluminum coated spring coil or crimped wire. Minimum weight of aluminum coating shall be 0.40-ounces per square foot of wire surface. The tension wire shall be stretched taut between terminal posts and securely fastened to each intermediate post 2-inches above the finish grade line. Tension wire shall be attached to the fence fabric with aluminum hog rings every 24-inches.
- E. Stretcher Bars: Stretcher bars shall be no less than 3/16-inch by 3/4-inch in cross section and shall have minimum length 2-inches longer than the fabric height. Stretcher bars shall be used for attaching the fabric to all terminal posts by threading through the fabric and being attached to the posts with No. 9-gauge tension bands, or other positive mechanical means, spaced at 24-inch centers. One (1) stretcher bar shall be provided for each gate and end post and 2 for each corner and pull post.
- F. Ties and Clips: Fabric shall be fastened to all intermediate posts with 9-gauge tie wires, spacing not to exceed 12-inches apart. Fabric shall be tied to top rail with 9-gauge tie wires, spacing not to exceed 24-inches on centers.

### **3.02 INSTALLATION**

- A. Post Setting: Line posts shall be set in holes 12-inches in diameter, 42-inches deep with 36-inch post embedment. Terminal posts shall be set in holes 15 inches in diameter, 42

inches deep, with 36-inch post embedment. After the post has been set and plumbed, the hole shall be filled with concrete. The exposed surface of the concrete shall be crowned to shed water.

- B. Terminal and Gateposts: Terminal and gateposts shall be set as specified above and shall be braced to the nearest post with a galvanized horizontal brace used as a compression member and a galvanized 3/8-inch steel truss rod and turnbuckle used as a tension member.
- C. Fabric: Fabric shall not be stretched until concrete footings have cured a minimum of 3-days. Chain link fabric shall be placed on the side designated by the County and shall be stretched taut approximately 2-inches above finish grade and securely fastened to all posts. Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

END OF SECTION

## SECTION 02850

### PLANT MOTORIZED GATE

#### PART 1 - GENERAL

##### 1.01 SCOPE

- A. This section covers design, furnishing, and installation of a motorized entrance gate which includes, but is not limited to, security control panels, power supplies, gate and gate operators, gate control panels and Plant Control System (PCS) interface. The gate shall consist of two opposing sliding cantilevered gates with motorized operators as shown on the drawings and specified herein.
- B. The motorized gate shall be compatible with OWNER existing Plant Control System (PCS) interface. The System Supplier shall be responsible to provide all equipment specified herein, and shall subcontract the gate and gate control system to an OWNER approved, certified installer. Gate operator system shall be provided with Electronic Card Access System (ECAS) as per Orange County's standards with all the accessories as stated in this specification and as shown on instrumentation drawings.
  - 1. A desk mounted control panel which contains auto/manual open gate swing arm switches is located inside the guardhouse that allows the guard to open (and hold open) all gate swing arms and the main gate. When the gate swing arm switch is in auto mode, the gate swing arms are actuated by security badge reader and Lenel system.
  - 2. Main Gate may also be opened by Plant Control System (PCS). Provide a key switch for the HySecurity control unit to select normal/night mode. When in night mode, the gate will close and disables the Gate Manual Open switch in the gate house.
  - 3. All exiting from the plant will automatically open main gate and exit gate swing arm via vehicle detector loops
- C. All associated equipment, devices, cabling (fiber-optic and copper), system configuration, and controls necessary for proper operation shall be included.

#### PART 2 - PRODUCTS

##### 2.01 GENERAL

- A. The System Supplier shall furnish all installation drawings, tools, equipment, conduit, wiring, materials, and supplies and shall perform all labor to complete the work as specified, and in compliance with all applicable codes, standards, and regulations.
- B. System Supplier shall coordinate with CONTRACTOR and any sub-contractors (including electrical) to provide all additional conduit and wiring required for a complete operable system beyond the use of conduit marked for security use as shown on drawings.

- C. The System Supplier shall review the specifications and supply equipment that meets the functional requirements indicated, and shall furnish and install additional or differing components if required.

## 2.02 SUPPLIER

### A. Supplier's Qualifications

- 1. The design, equipment, installation, and installation supervision furnished under this section shall be provided by a manufacturer or supplier who has been engaged in the business of supplying these types of equipment for at least 5 years.

### B. Governing Standards

- 1. All wiring and components shall meet the applicable requirements of the NEC.

### C. Nameplates

- 1. Major components of equipment shall be identified with a permanently affixed nameplate bearing the manufacturer's name and address, and type or style and catalog number of the item. Name plates shall be as specified in the Equipment, Valve, and Piping Identification section.

### D. Tags

- 1. Keys and locks, where required, shall be furnished with tags bearing stamped identification number. Cable and conduit runs, wiring circuits, and all spare parts supplied to maintain the equipment shall be furnished with tags. Tags shall be as specified in the Equipment, Valve, and Piping Identification section.

### E. Power Requirements

- 1. Primary power supply to all components will be 208 volt, 60 Hz., single phase. The System Supplier shall be responsible for meeting all additional power supply requirements and shall furnish any transformers or other power supply equipment needed.

## 2.03 SUBMITTALS

- A. Complete wiring diagrams; assembly and installation drawings; detailed specifications; and data covering the materials used and the parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. The equipment submittals shall include the following:

- 1. A complete description of all components, including certification of listing by UL.
- 2. Complete sequence of operation for all functions of the equipment.
- 3. Complete wiring diagram for all components and interfaces to equipment supplied under other sections or by the Owner.
- 4. Location drawings for all components.
- 5. A listing of the manufacturer's representatives responsible for installation and servicing.
- 6. Conduit and cabling to all equipment locations.

## 2.04 ELECTRIC MOTORIZED GATE

- A. The facility gate system shall be furnished as a complete package by the System Supplier consisting of a vehicular motorized slide gate as shown on the drawings and as specified herein. The gate system shall include the slide gate, automatic gate operator, and all required structural and safety equipment. Facility ingress shall be by through the Plant Control System (PCS) initiated by the SCADA operator at the Eastern Regional WSF or by the ECAS system at the Site entrance. Facility egress shall be by road imbedded proximity vehicle detector. The gate controller and gate operation shall be integrated with the Plant Control System (PCS).
- B. Slide Gate. The slide gate shall meet the following mechanical specifications:
1. The slide gate shall be the Traditional Georgian Cantilever type.
  2. Gates shall have 2"x 4" rectangular frame with a 2" vertical upright every four feet; 3/16" stainless steel aircraft table "X" bracing throughout.
  3. Gates shall have two (2) 2"x 1-1/2" stringers set in frame with 1" pickets set 3-1/8" o.c with a between space of 2-1/8".
  4. The slide gate construction shall be a non-ornamental, aluminum design. Gate shall conform to UL 325 standards. Field verify actual gate size.
  5. Gate will be coated with approximately 4-6 mil coat of TCI TG polyester powder coating. Verify color with OWNER.
  6. Provide crawl bar to eliminate crawl space under gate frame.
- C. Slide Gate Operator.
1. Gate operation shall be by means of a metal rail passing between a pair of solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300 pounds without the drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates weighing up to 4000 pounds. Gate panel velocity shall not be less than 1.7 feet per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly. The "soft stop" feature of the gate operator shall be controlled by two adjustable hydraulic brake valves (one for each direction). The "soft start" feature shall allow the pump to start at zero pressure, then progressively increase the pressure, over a period not less than two seconds, to 1,000 PSI. The gate operator shall be interfaced to the PCS for remote operation and override.
- D. Operator Code Requirements. The gate operator shall meet the following regulatory requirements.
1. Operators shall be built to UL325 standards. Installer shall ensure the automated gate installation conforms to the latest revisions of UL 325 and ASTM F2200.
  2. Current safety standards require the use of multiple external sensors to be capable of reversing the gate in either direction upon sensing an obstruction.
  3. Current safety standards require gate operators to be designed and labeled for specific usage classes. HySecurity Model 222 EX gate operators are to be used on

Class III and Class IV installations only.

- E. Functionality. The gate operator shall include the following specifications components and functionality.
1. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
  2. Limit switches: Fully adjustable, toggle types, with plug connection to control panel for gate open and gate closed.
  3. Vehicle Detection Loops: Entrance gate will have one inside and one outside obstruction loops. Exit gate will have one free exit loop, one inside obstruction and one outside obstruction loop. All loops to use HY5A loop detector.
  4. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories. Enclosure shall be NEMA Type 4X stainless steel.
  5. Hydraulic hose: Shall be 1/4" synthetic, rated to 2750 psi.
  6. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
  7. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
  8. Hydraulic fluid: High performance type with a viscosity index greater than 375.
  9. A zero to 2000-PSI pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
  10. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.
  11. Pump motor: Shall be a single phase, 60Hz, 208 VAC, 2 HP, 56C, TEFC, continuous duty motor, with a service factor of 1.15, or greater. All components shall have overload protection and NEMA Type 4X local disconnect/enclosure.
  12. Heater with thermostat control for damp humid climates.
  13. Gate controller: HySecurity Smart Touch Controller Board with 128K memory or and approved equal containing:
    - a. Inherent entrapment sensor;
    - b. Built in "warn before operate" system;
    - c. Built in timer to close;
    - d. Liquid crystal display for reporting of functions;
    - e. 19 programmable output relay options;
    - f. Anti-tailgate mode;
    - g. Built-in power surge/lightening strike protection;
    - h. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems.
  14. Required external sensors installed such that the gate is capable of reversing in either direction upon sensing an obstruction.
    - a. Provide two sets of UL approved EMX IRB photo safety beam with NEMA Type 4X enclosure or approved equal for each slide gate. One set to protect the open direction of gate travel and one set to protect the close direction of gate travel. Install eye no further than 5-inches from the face of the gate and between 21 and 27.5 inches from the roadway surface so that if the beam for the eye is blocked



- the gate will not operate.
- b. Siren operated sensor for fire department emergency ingress. Fire department to specify sensor frequency.
15. The gate operator shall be HySecurity Model 222EX 1.7 Heavy Duty Industrial Slide Gate Operator or approved equal.

F. Warranty. The gate and gate operator warranty is:

1. System Supplier one (1) year warranty on all labor and materials.
2. Manufacturers warranty on gate operator for five (5) years
3. Manufacturers warranty on gate drive wheels for two (2) years
4. Manufacturers warranty on all labor for one (1) year.
5. Manufacturers warranty to commence upon OWNER'S approval of satisfactory installation and startup.

## 2.05 SLIDE GATE CONTROLS AND ELECTRONIC CARD ACCESS SYSTEM (ECAS)

- A. An electric operated gate with Electronic Card Access System (ECAS) will be provided.
- B. The card access shall utilize County's existing ECAS pass cards and shall not require new access cards. Card entry system shall be provided at the main gate. ECAS and gate controller shall be connected into the new security control system that is provided by the I & C supplier as per I-drawings.
- C. HID 5355-A-G-K ProxPo card reader with a copper connection from the reader to the local gate control equipment. The copper connections shall be installed in a ¾" aluminum conduit.
1. Lenel LNL-2220 Intelligent Dual Reader Controller (inside panel unit) 12 VDC or 24 VDC @ 700mA, size (6" (152 mm) W x 8" (203 mm) L x 1" (25 mm), (5 year lithium battery or 3 months full run) 6 MB standard cardholder flash memory, 50,000 of event memory, maximum of 32 devices.
  2. Lenel LNL-1320 Dual Reader Interface Module (outside panel unit) (Series 2 supports OSDP readers) 12/24 VDC, 2 reader interface, W/M, 8 inputs, 6 (5A) form C relays, RoHS, CE, C-Tick and UL294 certified cutsheet URL: [http://www.lenel.com/sites/default/files/HW\\_LNL-1320-series2.pdf](http://www.lenel.com/sites/default/files/HW_LNL-1320-series2.pdf).
  3. ALLEGION AptiQ MTK!% Multi-Technology reader with keypad MTK15 or HID MultiCLASS SE RPK40 Wall Switch Keypad Reader Model 921PTNNEK00000.
  4. IFS International Fiber Systems d1300 fiber modules RS-485 2-wire Delta Transceiver, MM 2 fibers.
  5. Phoenix Contact Trio Power 2.5A 24V Power Supplies.
- D. Outdoor enclosure.
- E. FDC Aluminum Mounting Pedestal (Or Accepted Equal) for keypad (NWRP only).

- F. Three each - Vehicle loops sawn and sealed in existing asphalt pavement for safety and/or free exit operation.
- G. Radio controlled Miller safety edge (Or Accepted Equal).
- H. UL approved EMX IRB Photo Safety Beam set (Or Accepted Equal) and Aluminum Housing.
- I. Siren Operated Sensor and key switch for Emergency Access. Provide Siren Operated Systems, SOS VIII or equal. Knox Key Switch for emergency override, 3500 series by Knox Company or equal
- J. Gate supplier shall sub-contract to the I&C supplier (Curry Controls) for providing the gate security control panels, gate junction boxes, etc. as per Orange County's standards and as shown on I-drawings. All the equipment required for security control panel, gate junction boxes, etc. are listed in the I-drawings. Gate supplier shall coordinate with the sub-contractor for a complete and workings security gate system. Gate supplier shall coordinate with Electrical Contractor for all the interconnection conduit/cable requirements before bidding and notify the Engineer if any deviation is proposed from the design drawings. Gate supplier shall still be solely responsible for the operation of a complete gate package system.

## 2.06 OPERATION, MAINTENANCE AND INSTRUCTION MANUALS

- A. Operation, Maintenance and Instruction Manuals for the equipment and systems shall be furnished in accordance with Section 01720 – Project Record Documents and Section 01730 – Operating and Maintenance Data.
  - 1. All settings that are installed in Controller shall be documented and provided for a separate manual to be placed in the PLC panel.

## 2.07 MANUFACTURERS' FIELD SERVICES AND TRAINING

- A. Equipment manufacturers or suppliers shall provide the services of a factory-trained manufacturer's representative or agent and maintenance personnel as required to participate in installation, check-out, and testing of equipment and systems, and in the training of Owner plant operating personnel as required by Section 01650 – Startup and Demonstration and this section. The representative shall have complete knowledge of proper installation, operation, and maintenance of the equipment and systems supplied.
- B. The manufacturer's representative or agent shall visit the site or classroom designated by the Owner, for the minimum person-days listed below, travel time excluded.
  - 1. Full time as required. The System Supplier shall provide on-site supervision of installation.
  - 2. 3 days. Inspection, checking, and adjustment of equipment, including submittal of Manufacturer's Certificate of Proper Installation in accordance with 01650 – Startup

- and Demonstration.
3. 2 days. Participate in Functional Tests, Start-Up Tests, and Demonstration Tests and in preparation of required certifications in accordance with 01650 – Startup and Demonstration.
  4. 2 days. Participation in Manufacturer’s Training Services of Owner’s Personnel.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. All work shall be installed in accordance with the manufacturer's diagrams and recommendations except where otherwise indicated.
- B. After completion of the installation, the System Supplier shall clean the inside and the outside of the security equipment and shall remove any dirt and debris from the site.

#### **3.02 CABLE**

- A. Cable shall be installed in accordance with Section 16050. The conductors shall be installed in conduits or junction boxes separate from conductors of other systems. Conduit fill shall meet applicable NEC requirements.
- B. Raceways
  1. Conduit shall be installed in accordance with section 16050. Exposed conduit systems shall be rigid steel. Concealed conduit systems shall be PVC schedule 40.

### 3.03 FIELD QUALITY CONTROL, CHECKOUT AND TESTING

- A. The Contractor shall perform field quality control, checkout, and testing, and shall submit required documentation in accordance with Section 01650 – Startup and Demonstration, and any special field testing requirements as may be listed below or elsewhere in this section of these project specifications. Shop testing, if required, is addressed elsewhere in this section.
- B. Prior to starting any on-site testing the Contractor shall submit a testing protocol to the PM in accordance with the requirements of Section 01650. The protocol shall address preparation, calibration, testing procedures, measurement, and documentation for the required Functional, Start-Up, and Demonstration tests.

END OF SECTION

## **SECTION 02854**

### **ENTRANCE BARRIER ARM GATE WITH CARD ACCESS SYSTEM**

#### **PART 1 – GENERAL**

##### **1.01 SCOPE**

- A. This Section covers pre-wired barrier arm gate operator, complete with all pumps, valves, cylinders, and electrical devices to move gate arm and limit its travel in both directions.
- B. Arm and Fence Gates shall be controlled as follows:
  - 1. Entry Arm gate shall be opened by the Guard/Guardhouse control and by the Card Reader and Employee Card.
  - 2. Exit Arm gate shall be opened by the Guard/Guardhouse control and by embedded loop sensor in pavement.
  - 3. Fence Gate is controlled by PCS, Key Switch and Siren overrides.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Cast in place concrete: See section 03300.
- B. Electrical service and connections: See Division 16..

##### **1.03 SUBMITTALS**

- A. Shop drawings: Drawings and data shall be submitted in accordance with the Submittals section 01300. Submit drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the operator. Drawings shall also show the size and location of the concrete mounting pad. Underground electrical runs including vehicle detection loops shall be shown on shop drawings.
- B. Installation instructions: Submit two copies of manufacturer's installation instructions.
- C. Test reports:
  - 1. Submit affidavits from the manufacturer demonstrating that the gate mechanism has been tested to 200,000 cycles without breakdown.
  - 2. Each operator shall bear a label indicating that operator mechanism has been tested. Operators are tested for full power and pressure of all hydraulic components, full stress tests of all mechanical components and electrical tests of all overload devices.

##### **1.04 SUPPLIERS AND INSTALLERS QUALIFICATION**

- A. The design and equipment furnished under this Section shall be provided by a manufacturer or supplier specializing in the manufacture of hydraulic gate operators of

the type specified, with a minimum of ten years experience. The card access system equipment supplier shall be Lenel.

- B. Installer: The installation supervision personnel must have a minimum of three years experience installing similar equipment.

#### 1.05 CODES AND REGULATORY REQUIREMENTS

- A. Operators shall be built to UL 325 standards and listed by a testing laboratory. Complete all electrical work according to local codes and National Electrical Code. All fieldwork shall be performed in a neat and professional manner to journeyman standards.
- B. Vehicle gates should never be used by pedestrians. Separate pedestrian gates need to be provided when foot traffic is present.
- C. Current safety standards require gate operators to be designed and labeled for specific usage classes. The gate operator to be submitted needs to be listed for use in all UL 325 Usage Classes, I, II, III, and IV.
- D. NOTE: To be compliant with UL 325 and Industry safety guidelines, additional entrapment protection devices may need to be installed with this gate operator if the moving arm will travel within 24 inches of a stationary object.

#### 1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store products upright in original shipping containers, covered, ventilated, and protected from all weather conditions. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

#### 1.07 WARRANTY

- A. Provide five-year warranty against all defects in materials or quality of labor. Defective materials shall be replaced with comparable materials furnished by manufacturer at no cost to Owner.

### **PART 2 – PRODUCTS**

#### 2.01 ACCEPTABLE PRODUCTS

- A. Manufacturer of the barrier arm gate operator shall be HySecurity model Strong Arm 14 F UPS (HTG 320-2 DC ST) with Smart Touch Controller or equal.

#### 2.02 OPERATION

- A. Operation shall be by means of a hydraulic cylinder pulling a crank arm that rotates the output through 90 degrees. Travel time not to exceed 2 seconds from fully closed to fully open position. Maximum arm length shall be 14'. Operator body and chassis shall be made of 10-gauge steel with a cover of 14-gauge steel to allow operation in strong winds

without operator twisting. Operation to fully open and fully closed positions shall be limited by cam-operated switches that accurately read position of the shaft and arm. Spring counterbalance shall not be required. Gears, sprockets, or belts shall not be incorporated in operator. Standard finish of the operator chassis and body shall be Safety Yellow. All models include 2 brake valves to gradually stop and hold the arm without applying a shock load to the arm or operator assembly. Manual operation, in case of power failure, shall be accomplished by the use of a "pull to release" bypass valve that unlocks the operator and allows the arm to be moved by hand.

B. Standard components shall include as a minimum:

1. Chassis shall be 10-gauge steel plate, welded, and edges ground smooth.
2. Cover shall be 14-gauge galvanized sheet steel with all joints welded, filled, and ground smooth.
3. Output shaft shall be 1¼" diameter, high strength steel alloy.
4. Crank arm shall be made of ¾" plate steel.
5. Heavy duty sealed 1¼" bearings with 4 bolt flanges.
6. Adjustable physical stop limiting close travel to prevent arm from sagging below a level position.
7. Counterweights shall be used for any arm 20 feet and longer; utilize a yoke assembly to evenly distribute load.
8. Hydraulic hose shall be ¼" synthetic, rated to 2750 PSI.
9. Arm striping shall be reflective orange and white diagonal stripes 6" in width.
10. Safety Yellow finish over a pretreatment produces enduring finish proven to withstand 1000-hour salt spray test.

C. Minimum standard electrical components:

1. Pump motor: ¾ HP minimum, 56C, 24V DC motor.
2. Motor shall have internal overload protection.
3. Electrical enclosure shall be rated NEMA 1 and have a hinged door.
4. Controls: Controller Board with 256K memory containing:
  - a. Bi-directional traffic mode;
  - b. Built in "warn before operate" system;
  - c. Built in timer to close;
  - d. Liquid crystal display for reporting of functions;
  - e. 26 programmable output relay options;
  - f. Anti-tailgate mode;
  - g. Built-in power surge/lightening strike protection;
  - h. Menu configuration, event logging, and system diagnostics easily accessible with a PC and software; and
  - i. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems.
5. Control circuit shall be 24 VDC.
6. Low voltage sensor to protect batteries from over discharge. Last operation can be programmed for fail secure or fail open.
7. AC power loss operation can be programmed to open immediately or stay open after next normal operation or remain in normal operation until batteries are low.
8. Permanently sealed, maintenance free, lead acid batteries in separately insulated and ventilated enclosure.

9. Limit switches shall be adjustable to control maximum travel.
- D. Control devices: card reader, key switch, pushbuttons, vehicle obstruction loop detectors, and various Emergency vehicle open devices as dictated by local code or keypad.
- E. External sensors for stopping or reversing the gate travel: photo-eyes.
- F. Other features:
  1. Heater with thermostat for cold or damp climates.
  2. "Warn before operate buzzer".
  3. HY-5A plug in type vehicle detectors.
  4. 1 3/4" x 4 1/2" fiberglass arm.
  5. Arm Length (in 2' increments): 12', 18', 18' and Arm Material: Fiberglass.
  6. Voltages: 115 single phase.

## 2.04 FACTORY TESTING

- A. At the factory, fully assemble and test each gate operator to assure smooth operation, sequencing, and electrical connection integrity. Apply physical loads to the operator to simulate field conditions. Tests shall simulate physical and electrical loads equal to the fully-rated capacity of the operator components.
- B. Check all mechanical connections for tightness and alignment. Check all welds for completeness and continuity. Check welded corners and edges to ensure they are square and straight.
- C. Inspect painted finish for completeness and gloss. Touch up imperfections prior to shipment.
- D. Check all hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operation.

## PART 3 – EXECUTION

### 3.01 SITE EXAMINATION

- A. Locate concrete mounting pad in accordance with approved shop drawings and in compliance with local building codes.

### 3.02 INSTALLATION

- A. Install gate operator in accordance with the manufacturer's printed instructions, current at the time of installation. Coordinate locations of operators with contract drawings, other trades and shop drawings.
- B. Installer shall insure that the electric service to the operator is at least 20 AMPS. Operator wattage is 1500.



### 3.03 FIELD QUALITY CONTROL

- A. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when equipment is placed in operation in accordance with the Startup Requirements section and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.
- B. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed. The following need to be tested for the installed equipment:
  - 1. Test gate operator through ten full cycles and adjust for operation without binding, scraping or uneven motion. Test limit switches for proper "at rest" gate position.
  - 2. All anchor bolts shall be fully concealed and fully tightened in the finished installation.
- C. Owner, or Owner's representative, shall complete "punch list" with installing contractor prior to final acceptance of the installation and submit completed warranty documentation to manufacturer.

### 3.04 CONTINUED SERVICE AND DOCUMENTATION

- A. The manufacturer's representative is responsible for training Owner's personnel on how to safely shut off electrical power and release and manually operate barrier arm. Additional demonstration of the general maintenance of the gate operator and accessories also need to be provided. Manufacturer needs to provide one copy of "Installation and Reference" manual for the owner's use. Manuals will identify parts of the equipment for future procurement; provide maintenance personnel direct contact information and the technical support sections.

END OF SECTION

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**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 1½-in of the face of the concrete. The part of the tie to be removed shall be at least ½-in diameter or be provided with a wood or metal cone at least ½-in diameter and 1½-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 1½-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 watertightness 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

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**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. For all cast-in-place concrete tanks, retaining walls, building stem walls, wall sections shall be included in the drawings.
  - 2. Bar bending details. The bars shall be referenced to the same identification marks shown on the placement drawings.
  - 3. Schedule of all placements to contain synthetic reinforcing fibers. The amount of fibers per cubic yard to be used for each of the placements shall be noted on the schedule. The name of the manufacturer of the fibers and the product data shall be included with the submittal.
- B. Submit Test Reports, in accordance with Section 01300, of each of the following items.
  - 1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.
  - 2. Welder's certification. The certification shall be in accordance with AWS D1.4 when welding of reinforcement required.

## 1.04 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
  
- E. 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. 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.

## 1.06 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 1½ 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 – ¾-in
    - b. Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1½-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

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## 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. (Non-extruding 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. 679 or approved equal for construction joints. The waterstop shall be Greenstreak Group Inc. model No.732 or approved equal for control joints and Greenstreak Group Inc. Model No. 738 for expansion joints. Provide grommets or pre-punched holes spaced at 12 inches on center along length of waterstop.
2. Factory Fabrications: Provide factory made waterstop fabrications for all changes of direction, transitions, and intersections, leaving only straight butt joints of sufficient length for splicing in the field.

### B. Special Waterstops:

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

### C. Pre-molded Joint Filler:

1. Pre-molded joint filler - Structures. Self-expanding cork, pre-molded joint filler shall conform to ASTM D1752, Type III. The thickness shall be  $\frac{3}{4}$ -in unless shown otherwise on the Drawings.
2. Pre-molded 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  $\frac{3}{4}$ -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 pre-molded 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 1½-in of expansion.
2. Dowel Bar Sleeves: Provide Greenstreak two component Speed Dowel System, to accept 1-in diameter x 12-in 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.; Concreive 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 ½-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 pre-molded 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<sub>3</sub>A being below 5 percent of total cementitious content, Type III limited to 5 percent C<sub>3</sub>A 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 nonsegregating 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-in thick or less and the wall height exceeds 12-ft a mix including a plasticizer must be used.
  - 4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.
- G. Pozzolan (Fly Ash): Pozzolan shall be Class C or Class F fly ash complying with ASTM C618 except the Loss on Ignition (LOI) shall be limited to 3 percent maximum.

- H. Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting all complying with ASTM C171.
- I. Liquid Curing Compound. Liquid membrane-forming curing compound shall comply with the requirements of ASTM C309, Type 1-D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. Curing compound shall be approved for use in contact with potable water after 30 days (non-toxic and free of taste or odor). Curing compound shall comply with Federal, State and local VOC limits.

## 2.03 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. Re-tempering (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. Surfaces of Concrete Joints: Water cured or sheet material cured.
- C. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.
- D. Cold Weather Concreting:
- 1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.
  - 2. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified herein. Temperatures at the concrete placement shall be recorded at 12 hour intervals (minimum).
  - 3. Discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.
  - 4. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
    - a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (eg: 5 days at an average 70 degrees F = 350 degree-days).
    - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
  - 5. Salt, manure or other chemicals shall not be used for protection.
  - 6. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.
- E. Hot Weather Concreting:
- 1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lbs/sqft/hr).
  - 2. Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.

- a. Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
  - b. All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.
  - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
3. Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

### 3.06 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

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**SECTION 03350**  
**CONCRETE FINISHES**

**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 1½ 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 Damp-proofing: Rough-form finish. See Paragraph 3.01D above.
  - 2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough-form finish. See Paragraph 3.01D above.
  - 3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E above.
  - 4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E above.
  - 5. Vertical Concrete in Water Containment Areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level: Rough-form finish on remainder of submerged areas. See Paragraphs 3.01E and 3.01D above.
  - 6. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E above.
  - 7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.
  - 8. Interior or Exterior Horizontal Concrete not Requiring Floor Hardener or Sealer: Floated finish. See Paragraph 3.02A above.
  - 9. Concrete for Exterior Walks, Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.
  - 10. Concrete Slabs On Which Process Liquids Flow or In Contact with Sludge: Steel trowel finish. See Paragraph 3.02C above.
  - 11. Concrete to Receive Hardener: See Paragraph 3.03 above.
  - 12. Concrete to Receive Floor Sealer: See Paragraph 3.02D above.
  - 13. Concrete tank bottoms to be covered with grout: See Section 03600.

END OF SECTION

## **SECTION 03600**

### **GROUT**

#### **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.
- E. Masonry Grout is included in Section 04230.

##### **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. Non-shrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- E. Non-shrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.07 DEFINITIONS

- A. Non-shrink 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. Non-shrink Cementitious Grout:

1. Non-shrink 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. Non-shrink 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 non-shrink 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 ½-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 affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to a minimum of ¼-in 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 non-shrink 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 non-shrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable non-shrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable non-shrink grout for general purpose non-shrink 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 non-shrink 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 03740**

### **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 to the Engineer, in accordance with Section 01300, a schedule of Demolition and the detailed methods of demolition to be used at each location.
- B. 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.
- C. 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 revision in effect at the time of bid opening shall apply.

#### 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:
    - 1) Compressive Strength (ASTM D695): 8500 psi minimum at 28 days.
    - 2) Tensile Strength (ASTM D638): 4000 psi minimum at 14 days.
    - 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days.
    - 4) Shear Strength (ASTM D732): 5000 psi minimum at 14 days.
    - 5) Water Absorption (ASTM D570 - 2 hour boil): One percent maximum at 14 days.
    - 6) Bond Strength (ASTM C882) Hardened to Plastic: 1500 psi minimum at 14 days moist cure.
    - 7) Effective Shrinkage (ASTM C883): Passes Test.
    - 8) Color: Gray.
  3. Approved manufacturers include: Sika Corporation, Lyndhurst, NJ - Sikadur 32, Hi-Mod; Master Builder's, Cleveland, OH - Concrecive 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 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:
    - 1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
    - 2) Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum.
    - 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 14 days.
    - 4) Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
    - 5) Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.
    - 6) Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.
    - 7) Color: Concrete grey.
  3. Approved manufacturer's include:
    - a. Sika Corporation, Lyndhurst, N.J. - Sikadur Hi-mod LV 32; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.
    - b. Overhead applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-mod LV 31; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.

D. Repair Mortar:

1. General:
  - a. Repair mortar shall be a two-component, polymer modified, cement based, fast-setting, trowel grade, structural repair mortar suitable for use on horizontal, vertical and overhead surfaces prepackaged product specifically formulated for the repair of concrete surface defects.

2. Material:
  - a. Properties of the cured material:
    - 1) Compressive Strength (2 hours 50 percent RH) – 150 psi minimum
    - 2) Compressive Strength (28 days 50 percent RH) – 150 psi minimum
    - 3) Bond Strength (pull off method) – 100 percent concrete substrate failure
    - 4) This system shall conform with ANSI/NSF standards for surface contact with potable water.
  3. Approved manufacturer's include:
    - a. Sika Corporation, Lyndhurst, N.J. – SikaTop 122 PLUS or equal.
    - b. Overhead applications: Sika Corporation, Lyndhurst, N.J. – SikaTop 123 PLUS or equal.
- E. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, Non-Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600 GROUT.
- F. 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.
- G. Acrylic Latex Bonding Agents shall not be used for this project.
- H. 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 system that conforms with ANSI/NSF standards for surface contact with potable water.
  2. Material:
    - a. Properties of the cured material
      - 1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
      - 2) Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break - 2 to 5 percent.
      - 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)
      - 4) Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
      - 5) Water Absorption (ASTM D570 - 2 hour boil): 1.5 percent maximum at 7 days.
      - 6) Bond Strength (ASTM C882): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.
      - 7) 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 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

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**SECTION 05500**  
**MISCELLANEOUS METAL**

**PART 1 – GENERAL**

1.01 SCOPE OF WORK

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

1.02 RELATED WORK

- A. Concrete joint accessories are included in Section 03350.
- B. Masonry reinforcement, ties and accessories are included in Division 4.
- C. FRP Doors and frames are included in Section 08100.
- D. Painting is included in Division 9.
- E. Louvers are included in Division 10.
- F. Sluice gates, slide gates, operators and appurtenances, including wall thimbles, are included in Division 11.
- G. Pipe hangers and sleeves are included in Division 15.
- H. Equipment anchor bolts are included in the respective Sections of Divisions 11, 14, and 15.

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. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.
- B. Samples:
  - 1. Submit samples as requested by the Engineer during the course of construction.

C. Design Data:

1. Submit calculations or test data demonstrating that the railings will resist the loads specified in the 2010 Florida Building Code at the post spacing provided.
2. Submit manufacturer's load and deflection tables for grating.

D. Test Reports:

1. Certified copy of mill test reports on each aluminum proposed for use showing the physical properties and chemical analysis.

E. Certificates:

1. Submit certification that the railing system is in compliance with OSHA requirements and the 2010 Florida Building Code.
2. Certify that welders have been qualified under AWS, within the previous 12 months, to perform the welds required under this Section.

#### 1.04 REFERENCE STANDARDS

A. Aluminum Association (AA):

1. ABH-21 Aluminum Brazing Handbook
2. ASD-1 Aluminum Standards and Data
3. DAF-45 Designation System for Aluminum Finishes
4. SAA-46 Standards for Anodized Architectural Aluminum

B. American Society for Testing and Materials (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A48 - Standard Specification for Gray Iron Castings.
3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
8. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.



13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. ASTM A536 - Standard Specification for Ductile Iron Castings.
15. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
16. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
17. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
18. ASTM B429 – Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Iron and Steel Institute (AISI):

1. Specification for Structural Steel Buildings.

D. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code Steel.
2. AWS D1.2 – Structural Welding Code Aluminum.

E. Federal Specifications:

1. FS-FF-B-575C – Bolts, Hexagonal and Square

F. Occupational Safety and Health Administration (OSHA).

G. 2010 Florida Building Code. (FBC).

H. 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. 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.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.
- C. All welding shall be performed by qualified welders and shall conform to the applicable AWS welding code. Welding of steel shall conform to AWS D1.1 and welding of aluminum shall conform to AWS D1.2.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
- B. Repair items which have become damaged or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

## 1.07 PROJECT/SITE REQUIREMENTS

- A. Field measurements shall be taken at the site, prior to fabrication of items, to verify or supplement indicated dimensions and to ensure proper fitting of all items.

## **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. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

### 2.02 MATERIALS

- A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:
  - 1. Structural Steel – Wide flange shapes: ASTM A992
  - 2. Structural Steel – Other Shapes; plates; rods and bars: ASTM A36
  - 3. Structural Steel Tubing: ASTM A500, Grade B
  - 4. Welded and Seamless Steel Pipe: ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work
  - 5. Steel Sheets: ASTM A366
  - 6. Gray Iron Castings: ASTM A48, Class 35
  - 7. Ductile Iron Castings: ASTM A536, Grade 65-45-12
  - 8. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6
  - 9. Aluminum Extruded Shapes: ASTM B221, Alloy 6061 T6
  - 10. Aluminum Sheet and Plate: ASTM B209, Alloy 6061 T6

11. Stainless Steel Plates, Sheets, and Structural Shapes	
a. Exterior, Submerged or Industrial Use	ASTM A240, Type 316 (Type 316L for welded)
b. Interior and Architectural Use	ASTM A240, Type 304
12. Stainless Steel Bolts, Nuts, and Washers	ASTM A276, Type 316
13. Titanium Bolts, Nuts, and Washers	ASTM F468, F467
14. Hastelloy C-276 Bolts	ASTM B574
15. Carbon Steel Bolts and Studs	ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
16. High Strength Steel Bolts, Nuts and washers	ASTM A325 (mechanically galvanized per ASTM B695, Class 50, where noted)
a. Elevated Temperature Exposure	Type I
b. General Application	Type I or Type II
17. Galvanizing	ASTM A123, Zn w/0.5 percent minimum Ni
18. Galvanizing, hardware	ASTM A153, Zn w/0.5 percent minimum Ni

### 2.03 ANCHORS, BOLTS AND FASTENING DEVICES

- A. Anchor bolt material shall be ASTM A307, Grade A (hot dip galvanized butts and washers where noted), or ASTM F1554, Grade 36- Standard headed anchor bolts.
- B. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel machine bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel machine bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel machine bolts.
- C. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel, wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are required. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwick-bolt III; ITW Ramset; Redhead trubolt, or equal.
- D. Compound masonry expansion anchors shall be lead expansion sleeve type anchors complete with nuts and washers. Anchors shall be precision die-cast zinc alloy with a minimum of two lead alloy expansion sleeves. When the length or embedment of the

bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Star Expansion Industries, Star Slugin or equal.

- E. Adhesive capsule anchors shall be a two-part stud and capsule chemical resin anchoring system. Capsules shall contain premeasured amounts of polyester or vinyl ester resin, aggregate and a hardener contained in a separate vial within the capsule. Stud assemblies shall consist of an all-thread anchor rod with nut and washer. Adhesive capsule anchors shall be Hilti, HVA Adhesive Anchor; Molly, Parabond; Rawlplug, Rawl Chem-Stud or equal.
- F. Adhesive anchors, for fastening to hollow concrete block or brick, shall be a three-part stud, screen and chemical dispenser anchoring system. Adhesive cartridges shall contain premeasured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of an all-thread anchor rod with nut and washer. Anchors shall be Hilti, HIT C-20 System or equal.
- G. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or equal.
- H. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- I. Toggle bolts shall be Hilti, Toggler Bolt or equal.

## 2.06 ACCESS HATCHES

- A. Access hatches shall have single or double leaf doors as indicated by the Drawings. The doors shall be 1/4-in aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a live load of 300 lbs/sq ft with a maximum deflection of 1/150th of the span. Hatches shall have a 1/4-in aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Hatches shall be watertight and have a 1-1/2-in drainage coupling to the channel frame. Access hatches shall be Types as indicated on the Drawings by Bilco Company, New Haven, CT or equal.

## 2.07 MISCELLANEOUS ALUMINUM

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings, and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.
- D. Angle frames for hatches, beams, grates, etc, shall be complete with welded strap anchors attached.
- E. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8-in. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 304 stainless steel. Plates shall have a mill finish.
- F. Stair treads for aluminum stairs shall have abrasive non-slip nosing as approved.
- G. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12-in on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3-in at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.
- H. Miscellaneous aluminum items shall have a cleaned and degreased mill finish.

## 2.08 MISCELLANEOUS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- D. Structural steel angle and channel door frames shall be shop coated with primer. Frames shall be fabricated with not less than three anchors on each jamb.
- E. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.
- F. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be shop coated with primer.
- G. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.
- H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface.

## 2.09 MISCELLANEOUS STAINLESS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous stainless steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

## **PART 3 – EXECUTION**

### 3.01 INSTALLATION

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
- B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.
- C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.
- D. Specialty products shall be installed in accordance with the manufacturer's recommendations.
- E. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.

- F. Install adhesive capsule anchors using manufacture's recommended drive units and adapters and in compliance with the manufacturer's recommendations.
- G. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.
- H. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- I. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
- J. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
- K. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- L. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

END OF SECTION



## SECTION 09900

### PAINTING

#### PART 1 – GENERAL

##### 1.01 SCOPE OF WORK

- A. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for 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 exposed items and surfaces such as ceilings, walls, floors, miscellaneous metal, doors, frames, transoms, roof fans, construction signs, guardrails, posts, pipes, fittings, valves, equipment, and all other work obviously required to be painted unless otherwise specified herein or on the Drawings. Minor items omitted in the schedule of work shall be included in the work of this section where within the general intent of the specifications as stated herein. The following major items of the Project shall be coated:
1. Interior of cast-in-place concrete, concrete block walls, concrete ceilings and concrete floors; and exterior concrete block and stucco walls.
  2. Exposed ferrous surfaces of equipment, pumps, motors, tanks and ferrous or galvanized metal fittings and accessories.
  3. Exposed surfaces of PVC components of piping, fittings, valves, electrical conduit and equipment.
  4. Exposed exterior surfaces of all metallic piping, fittings and valves located on the interior and exterior of buildings and structures. This shall include new piping, fittings and valves for the Project.
  5. Embedded aluminum or aluminum in contact with dissimilar metals or in contact with corrosive atmospheres.
- C. The following surfaces or items are not required to be field painted:
1. Portions of metal other than aluminum embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in or in contact with concrete shall be coated to prevent electrolysis.
  2. Brass, bronze, and aluminum other than exposed tubing.
  3. Piping buried in the ground or embedded in concrete.
  4. Ducts, pipes and other miscellaneous items covered with insulation or plastic coated.
  5. Stainless steel angles, tube, pipe, etc. unless specified or shown to be coated.
  6. Fiberglass.
  7. Aluminum or fiberglass handrails, walkways, toeboards, windows, louvers, grating, checker plate, hatches, and stairways.

8. Finish hardware.
9. Products with polished chrome, aluminum, nickel or stainless steel finish.
10. Plastic switch plates and receptacle plates.
11. Electrical switchgear and motor control centers.
12. Any code-requiring labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

## 1.02 SUBMITTALS

- A. Submit to the Engineer as provided in the General Conditions and Section 01300, shop drawings, manufacturer's specifications and data on the proposed paint systems and detailed surface preparation, application procedures and dry film thickness.
- B. Submit documentation of paint contractor's and coating applicator's experience applying the specified coatings.
- C. When the proposed products will be in contact with treated or raw water in potable water treatment facilities, Contractor shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.
- D. Schedule of Painting Operations:
  1. Contractor shall submit for approval a complete Schedule of Painting Operations within 90 days after the Notice to Proceed. This Schedule is imperative so that the various fabricators may be notified of the proper shop prime coat to apply. It shall be the Contractor's responsibility to properly notify and coordinate the fabricators' surface preparation and painting operations with these Specifications.
  2. This Schedule shall include for each surface to be painted, the brand name, the volume solids, the coverage and the number of coats the Contractor proposes to use in order to achieve the specified dry film thickness, and color charts. When the Schedule has been approved, the Contractor shall apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gages may be utilized by the Owner's representative to verify the proper application while Work is in progress.
- E. Color Samples: Manufacturer's standard color charts for color selection by Owner.
- F. Samples-Painting:
  1. Paint colors will be selected by 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 Owner or 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 (3) coat work is specified, the sample shall be divided into three (3) areas:
    - a. One (1) showing the application of one (1) coat only.

- b. One (1) showing the application of two (2) coats.
- c. One (1) showing the application of all three (3) coats.
- 4. Such samples when approved in writing shall constitute a standard, as to color and finish only, for 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.

### 1.03 DELIVERY, HANDLING AND STORAGE

- A. Deliver all materials to the job site in original, unopened packages and containers bearing manufacturer's name and label in accordance with Section 01610: Materials and Equipment. Provide labels on each container with the following information:
  - 1. Name or title of material.
  - 2. Fed. Spec. number if applicable.
  - 3. Manufacturer's stock number, date of manufacture and expiration date (shelf life).
  - 4. Manufacturer's formula or specification number.
  - 5. Manufacturer's batch number.
  - 6. Manufacturer's name.
  - 7. Generic type.
  - 8. Contents by volume, for major pigment and vehicle constituents.
  - 9. Application instructions: thinning, ambient conditions, etc.
  - 10. Color name and number.
- B. 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.
- C. Material Safety Data Sheets shall be kept on-site and made readily available for all personnel.
- D. All containers shall be handled and stored in such a manner as to prevent damage or loss of labels or containers. Containers shall be kept sealed and ready for use. All materials shall be stored in a cool, dry area out of the direct sunlight and away from any ignition source. Contractor shall refer to the manufacturer's literature and material safety data sheets for additional storage requirements.
- E. Storage of paint materials and related equipment shall comply with the requirements of pertinent codes and fire regulations. In addition, all safety precautions noted on the manufacturer's Material Safety Data Sheets and other literature shall be strictly followed. Proper containers outside of buildings shall be provided by the Contractor and used for painting wastes. No plumbing fixtures shall be used for this purpose.

#### 1.04 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. Provide undercoat paint produced by the same manufacturer as the finish coats. Undercoat and finish coat paints shall be compatible. Use only thinners approved by the paint manufacturer, and use only within recommended limits.
- C. Painting shall be accomplished by experienced painters specializing in industrial painting familiar with all aspects of surface preparations and applications required for this project. The paint contractor shall have a minimum of 10 years experience in industrial painting . The applicator of System 3 shall have a minimum of five (5) years documented experience in the application of of polymer-based floor coatings to concrete floors.
- D. All work shall be proved to be in first class condition and constructed in accordance with the Drawings and specifications. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor at no expense to the Owner.
- E. 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.

#### 1.05 WARRANTY AND GUARANTEES

- A. All paint and coatings work performed under these specifications shall be guaranteed by the coatings applicator for 100 percent of the total coated area for both materials and labor against failures during the warranty period.
- B. Failure under this warranty shall include flaking, peeling, or delaminating of the coating due to aging, chemical attack, or poor workmanship; but it shall not include areas which have been damaged by unusual chemical, thermal, or mechanical abuse.

### **PART 2 – PRODUCTS**

#### 2.01 MATERIALS

- A. All paint shall be manufactured by one of the suppliers listed herein and shall be their highest grade of paint.
- B. The following coating systems list a product by name to establish a standard of quality; other products of the same generic types may be submitted to the Engineer for approval. When other than the specified coating system is proposed, the Contractor shall submit on a typewritten list giving the proposed coatings, brand, trade name, generic type and

catalog number of the proposed system for the Engineer's approval. Contractor shall submit sufficient data substantiated by certified tests, conducted at no expense to the Owner, to demonstrate its equality to the paint(s) named. Provide list and data to the Engineer for approval within 30 days after the Notice to Proceed. The type and number of tests performed shall be subject to the Engineer's approval.

- C. 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 underlying paint. Shop paint shall be of the same type and manufacture as used for field painting by the Contractor.
- D. No paint containing lead will be allowed. Oil shall be pure boiled linseed oil.
- E. Rags shall be clean painter's rags, completely sterilized.

## 2.02 COLOR CODING FOR PIPES AND EQUIPMENT

- A. Color coding shall consist of color code painting and identification of all exposed conduits, trough items and pipelines for the transport of gases, liquid and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and all operating accessories which are integral to be whole functional mechanical pipe and electrical conduit system. See Section 09905 Piping and Equipment Identification System.
- B. All hangers and pipe support floor stands shall be painted. The system shall be painted up to but not including the flanges attached to the mechanical equipment or the flexible conduit connected to electrical motors. Colors shall be designated by Owner.
- C. 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 fixed flanges or connections on the equipment.
- D. The color code establishes, defines and assigns a definite color for each category of pipe. Pipelines that are not listed on the Schedule of Color Code Paints shall be assigned a color by the Engineer and shall be treated as an integral part of the Contract.

## 2.03 FABRICATED EQUIPMENT

- A. Unless otherwise indicated all fabricated equipment shall be shop primed and field finished.
- B. All items to be shop primed shall be thoroughly cleaned of all loose material prior to priming. If, in the opinion of the Engineer, any prime coating has been improperly applied or if material contrary to these Specifications has been used, that coating shall be

removed by sandblasting to white metal and reprimed in accordance with these Specifications.

- C. All shop prime coats shall be of the correct materials and applied in accordance with these Specifications. The Contractor shall remove any prime coats not in accordance with these Specifications by sandblasting and apply the specified prime coat at no additional cost to the Owner.
- D. Shop primed surfaces shall be cleaned thoroughly and retouched with the specified primer before the application of successive paint coats in the field. Touch areas on ferrous metal surfaces shall be given spot sand blast to SSPCSP-10 and reprime.
- E. Contractor shall be responsible for taking whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- F. If, in the opinion of the Engineer, a shop finish coat does not give the protection quality of other Work of similar nature the Contractor shall apply the coat or coats of paint as directed by the Engineer to accomplish the desired protection quality.
- G. 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 by the Contractor.

## 2.04 COATING SYSTEMS

- A. System 1 – Interior Concrete and Masonry, Non-Immersion. Excludes all floors and slabs, and the bottom five feet of walls within the chemical buildings and pump rooms. Examples of this classification include the following surfaces:
  - 1. Examples of this classification include the following surfaces:
    - a. Masonry and plaster.
    - b. Concrete block walls.
    - c. Concrete walls, columns and supports.
    - d. Concrete ceilings and beams.
  - 2. Surface Preparation: Allow new concrete and mortar to cure 28 days. Level protrusions and mortar spatter.
  - 3. Filler: One coat of one of the following, or equal:
    - a. Tnemec Series 215 Surfacing Epoxy at 52 square feet per mixed gallon.
  - 4. Finish: Two (2) coats of one of the following, or equal:
    - a. Tnemec Series N69 Hi-Build Epoxoline II at 5.0 mils dry thickness per coat.
- B. System 2 – Exposed Concrete and Masonry, Non-Immersion.
  - 1. Examples of this classification include the following surfaces:
    - a. Exterior, aboveground concrete and concrete block wall surfaces of new and existing structures.

2. Surface Preparation: As specified in Paragraph 3.02 herein and in addition the following:
  - a. New concrete and masonry surfaces shall be prepared by filling cracks, voids and other surface imperfections, removing mortar droppings, cleaning and high pressure water blasting.
  - b. Existing concrete surfaces shall be prepared by high pressure water blasting or abrasive blast cleaning to remove existing deteriorated or disbonded coatings as required for adhesion of the new coating system.
3. Prime Coat for New Concrete Structures: Cement base waterproofing:
  - a. Thoro Systems Thoroseal: One (1) coat, 2 lbs per square yard.
4. Prime Coat for New Masonry Structures: Single-component cementitious acrylic masonry block filler:
  - a. Tnemec Series 130-6602 Envirofill at 80-100 sf/gal.
5. Prime Coat for Previously Coated Structures: Two component waterborne epoxy primer.
  - a. Tnemec Series 151 Elasto-grip at 300 sf/gal.
6. Finish Coats: High quality elastometric coating.
  - a. Tnemec Series 156 Envirofill; two coats at 5.0 mils DFT per coat.
7. Total minimum system finish coating thickness shall be 10.0 mils DFT over the primer or sealer.

C. System 3 – Concrete Floors and Masonry Walls, Chemical Resistant.

1. Examples of this classification include the following surfaces:
  - a. Concrete and masonry surfaces that are subject to splashing, spillage and fumes of chemicals.
  - b. Concrete floors and slabs, bottom 5 feet of concrete columns and masonry walls in hypochlorite and fluoride buildings.
2. Applicator shall have a minimum of five (5) years documented experience in the application of polymer-based floor coatings to concrete floors.
3. Surface Preparation: As specified in Paragraph 3.02 herein and in addition the following:
  - a. New concrete and masonry shall be cured for at least 28 days before lining is applied. New masonry surfaces shall be prepared by filling cracks, voids and other surface imperfections using a epoxy concrete filler, removing mortar droppings, cleaning and high pressure water blasting.
  - b. Concrete surfaces, including those with bug holes less than 1 inch [25 mm] in any dimension, shall be prepared using an epoxy concrete filler or as recommended by the material manufacturer and acceptable to Engineer.
  - c. Contractor shall repair all concrete surfaces that have spalls, voids, and cracks and shall remove all fins and other surface projections to produce a flush surface for application of the coating system. Grind concrete at edges of metal drains, troughs, and sumps to accommodate application of new coatings. Remove all loose old coatings, and scarify all surfaces by abrasive blasting, mechanical grinding or blastrac cleaning. Feather edges of old sound coatings to blend with

the new coating. Ensure all surfaces are clean, dry and abraded prior to application of any repair or coating materials.

- d. All concrete surfaces to be lined shall be cleaned in accordance with ASTM D4258 and abrasive blasted in accordance with ASTM D4259. Before the lining is applied, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue.
- e. Follow materials manufacturer's written instructions. All concrete and masonry surfaces shall be ready to receive the lining/coatings as determined by the materials manufacturer and accepted by the Engineer.
4. Repair all voids, spalls and areas of lost concrete. Fill control joints.
  - a. Flo-rock Florogel Epoxy Patch.
5. Prime Coat:
  - a. Crawford Laboratories Floropoxy 4700 Epoxy Primer. One application at 8 mils. Squeegee applied, backroll with nap roller at manufacturer's recommend spread rate.
6. Midcoat:
  - a. Crawford Laboratories Novolac Epoxy. Squeegee applied, backroll with nap roller at manufacturer's recommend spread rate.
7. Finish Coat:
  - a. Crawford Laboratories Novolac Epoxy. Squeegee applied, backroll with nap roller at manufacturer's recommend spread rate.

D. System 3 – Metals, Immersion (Interior and Exterior) and Non- Immersion (Interior)

1. Consist of interior and exterior metal surfaces (immersion) and interior metal surfaces that do not come in direct contact with water or corrosive atmospheres.
2. Examples of this classification include the following surfaces:
  - a. Pumps, motors, equipment and appurtenances.
  - b. Aboveground piping, fittings, valves and metal electrical conduit.
  - c. Miscellaneous steel plates, shapes, hardware, etc.
  - d. Galvanized steel surfaces.
  - e. Other surfaces obviously requiring field coating or as specified to be field coated in Division 11 or in Section 09905: Piping and Equipment Identification Systems.
3. Surface Preparation: As specified in Paragraph 3.02 herein and, in addition, the following:
  - a. Non-immersion metals shall be abrasive blast cleaned to SSPC-SP6. Immersion metals shall be abrasive blast cleaned to SSPC-SP10.
  - b. All bare metals or areas that were shop primed that have been damaged shall be abrasive blast cleaned to the appropriate, commercial blast cleaning standards.
  - c. 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 the appropriate, commercial blast cleaning standards, for areas where the primer has been damaged and bare metal is showing.



- d. Non-ferrous metals shall be degreased and cleaned by washing with a water based dispersant. Rinse thoroughly with clean water after cleaning.
  - 4. System 3 Coating System (Immersion)
    - a. Prime Coat for Ferrous and Non-Ferrous Metals: NSF Part 61 approved, two-part epoxy polyamide primer. Tnemec Series 140-1255 (Beige) Pota-Pox Plus at 4.0 mils DFT.
    - b. Finish Coat for Non-Ferrous Metals: NSF Part 61 approved epoxy coating. Tnemec Series 140-WH02 (Tank White) Pota-Pox Plus at 4.0 mils DFT.
    - c. Finish Coats for Ferrous Metal: NSF Part 61 approved, two component, cross linked epoxy. Tnemec Series 140 Pota-Pox Plus: Two coats at 5.0 mils DFT per coat.
    - d. Total minimum system finish coating thickness shall be 14.0 mils DFT for ferrous metals and 8.0 mils DFT for non-ferrous metals.
  - 5. System 3 Coating System (Non-Immersion)
    - a. Prime Coat for Ferrous and Non-Ferrous Metals: Two component, cross-linked epoxy primer. Tnemec Series 69 Hi-Build Epoxoline II at 4 mils DFT.
    - b. Finish Coat for Non-Ferrous Metals: Two-part epoxy. Tnemec Series 69 Hi-Build Epoxoline II at 3.0 mils DFT.
    - c. Finish Coat for Ferrous Metal: Two component, cross-linked epoxy. Tnemec Series 69 Hi-Build Epoxoline II at 5.0 mils DFT.
    - d. Total minimum system finish coating thickness shall be 9 mils DFT for ferrous metals and 7 mils DFT for non-ferrous metals.
- E. System 4 Exposures – Plastic Piping, Valves, Fittings and Conduit, Interior and Exterior
- 1. Class 7 exposures consist of PVC or fiberglass piping and structural shapes or electrical systems requiring color coding, and for protection of exposed, exterior plastic components from the elements, and shall include the following:
    - a. PVC and fiberglass piping, fittings, valves and electrical conduits requiring color coding in accordance with Section 09905: Piping and Equipment Identification System.
    - b. Exposed exterior plastic piping, valve and fitting components subject to UV degradation and weathering by the elements.
  - 2. Surface Preparation: As specified in Paragraph 3.02 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. System 4 Coating System:
    - a. Prime Coat: Two component epoxy. Tnemec Series 66 Hi-Build Epoxoline at 3.0 mils DFT.
    - b. Finish Coats for exterior surfaces: Tnemec Series 73 Endurashield at 3.0 mils DFT.
    - c. Finish coat for interior exposure: Tnemec Series 66 Hi-Build Epoxoline at 3.0 mils DFT.
    - d. Total minimum system finish coating thickness shall be 6 mils DFT.

F. System 5 Exposures – Aluminum

1. System 5 exposures consist of aluminum surfaces embedded or in contact with concrete, mortar or plaster, or aluminum in contact with dissimilar metals which may cause corrosion due to electrolysis, and shall include the following:
  - a. Aluminum surfaces in contact with concrete, mortar or plaster, such as hatch cover frames, stair stringers, portions of grating and frames, floor plate and frames, etc.
  - b. Aluminum surfaces in contact with dissimilar metals which may cause corrosion due to electrolysis.
2. Surface Preparation: As specified in Paragraph 3.02 herein, including solvent cleaning in accordance with SSPC-SP1 standards for solvent cleaning and scarification.
3. System 5 Coating System:
  - a. Prime Coat: Two component polyamide epoxy. Tnemec Series 66 Hi-Build Epoxoline at 3.0 mils DFT.
  - b. Finish Coats for Aluminum Exposed to View: Two-component, high build, acrylic urethane. Tnemec Series 73 Endurashield at 3.0 mils DFT.
  - c. Finish Coat for Aluminum Not Exposed to View: Polyamide cured coal tar epoxy. Tnemec Series 46H-413 Hi-Build Tneme-Tar applied at 16.0 mils DFT.
  - d. Total minimum system finish coating thickness shall be 19.0 mils DFT for areas not exposed to view or 6.0 mils for areas exposed.

G. System 6 Exposures – Metals Exterior Exposed

1. System 6 exposures consist of exterior metal surfaces exposed to the weather and environment.
  - a. Pumps, motors, equipment, and appurtenances
  - b. Above ground piping, fittings, valves, and metal conduit
  - c. Miscellaneous metal surfaces
  - d. Ladders, stairways, structural steel
  - e. Roof mounted equipment, hatches, fans, etc.
  - f. Galvanized and non-ferrous metal surfaces
  - g. Other surfaces obviously requiring field painting
2. Surface Preparation: As specified in paragraph 3.02 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 by washing with a water based dispersant such as Carboline Surface Cleaner #3. Rinse thoroughly with clean water after cleaning.

3. System 6 Coating System
  - a. Prime coat for ferrous and non-ferrous metal: Two part epoxy primer. Tnemec Series 69 Hi-Build Epoxoline II at 4.0 mils DFT.
  - b. Intermediate coat for ferrous metal: Two part epoxy. Tnemec Series 69 Hi-Build Epoxoline at 3.0 mils DFT.
  - c. Finish coat for ferrous and non-ferrous metal: High Build Acrylic Polyurethane. Tnemec Series 73 Endura-Shield at 3.0 mils DFT.
  - d. Total minimum system finish shall be 7.0 mils for non-ferrous metal and 10.0 mils for ferrous metal surfaces.

## **PART 3 – EXECUTION**

### **3.01 SHOP PAINTING**

- A. Surface Preparation – All ferrous metal to be primed in the shop shall have all rust, dust and scale, as well as all other foreign substances, removed by sandblasting or pickling in accordance with SSPC-SP5 or SP8, respectively. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Under no circumstances will cleaned metal be allowed to sit overnight before priming, or pretreatment and priming. All nonferrous metals shall be solvent cleaned prior to the application of primer. In addition, galvanized surfaces which are to be topcoated shall first be degreased then primed. All non-ferrous metal surfaces shall also be scarified prior to topcoating.
- B. Materials Preparation:
  1. Mix and prepare painting materials in strict accordance with manufacturer's recommendations and directions, stirring materials before and during application to maintain a mixture of uniform density, free of film, dirt and other foreign materials.
  2. No thinners shall be used except those specifically mentioned and only in such quantity as directed by the manufacturer in his 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 cleanup solvent shall be used for all clean-up. Application by brush, spray, airless spray or roller shall be as recommended by the manufacturer for optimum performance and appearance.
- C. Applications:
  1. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship. Coating systems shall be as specified herein.
  2. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied.
  3. All paint and coatings materials shall be stored under cover and at a temperature within 10°F of the anticipated application temperature and at least 5°F above the dew point.
  4. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

5. 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.
  6. Paint back sides of access panels and removable or hinged covers to match the exposed surfaces.
  7. Equipment manufacturer or supplier shall provide touch-up paint for items with shop applied finish coats.
  8. Where specified in the individual sections, primer coat(s) shall be applied in the shop by the equipment manufacturer. The shop coats shall be as specified and shall be compatible with the field coat or coats.
- D. Certification: The Contractor shall obtain from the equipment manufacturer or supplier, prior to shipment of equipment, a written certification that surface preparation, coating brand, material, DFT and application method complied with this Section.

### 3.02 PREPARATION OF SURFACES

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean interior concrete and concrete block surfaces to receive polyamide cured equipment of all marks before application of finish. Review all completed surface preparation with Owner's representative prior to applying coatings.
- B. All metal welds, blisters, etc., shall be ground and sanded smooth in accordance with SSPC-SP-3 or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC-SP-2. All weld spatter shall be removed and all fabricated metal with sharp edges shall be ground smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, grease and dirt shall be removed by use of approved solvents, wire brushing or sanding.
- C. All plastic pipe surfaces shall have surfaces lightly sanded before painting.
- D. Exposed Pipe: Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated pipe which is inadvertently installed in exposed locations shall be sandblasted clean before priming and painting. After installation all exterior, epoxied flanged joints shall have the gap between adjoining flanges sealed with a single component Thiokol caulking to prevent rust stains.
- E. Primed or Coated Surfaces and Nonferrous Surfaces: All coated surfaces shall be cleaned prior to application of successive coats. All nonferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.
- F. Shop-Finished Surfaces: All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon

detection. Abraded or corroded spots on shop-coated surfaces shall be "Hand Cleaned" and then touched up with the same materials as the shop coat. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up in the opinion of the Engineer shall be repainted. Cut edges of galvanized sheets and exposed threads and cut ends of galvanized piping, electrical conduit, and metal pipe sleeves, not to be finished painted, shall be "Solvent Cleaned" and prepared in accordance with SSPC-SP2 or SSPC-SP3 guidelines and then primed with a zinc phosphate metal primer such as Carboline Carbocoat 150 Universal Primer.

- G. Galvanized and Zinc-Copper Alloy Surfaces: These surfaces to be painted shall be "Solvent Cleaned" and treated as hereinafter specified. Such surfaces not to be painted shall be "Solvent Cleaned".
- H. Aluminum embedded or in contact with concrete shall be prepared in accordance with SSPC-SP7 guidelines and must be painted with one coat of aluminum epoxy mastic such as Carboline Carbomastic 15 .
- I. Ductile Iron: Reference the NAPF 500-03 surface preparation standard for ductile iron pipe and fittings in exposed locations receiving special external coating and/or special internal linings for applicable surface preparation guidelines.

### 3.03 WORKMANSHIP

#### A. General:

1. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Confirm with the paint manufacturer that the paint proposed for a particular re-paint condition will be compatible with the existing painted surface. Sample re-painted areas on the actual site will be required to insure this compatibility. Finished repainted areas shall be covered by the same guarantee specified for remainder of Work.
2. At the request of the Engineer, samples of the finished Work prepared in strict accordance with these Specifications shall be furnished and all painting shall be adequate for the purpose of determining the quality of workmanship. Experimentation with color tints shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.
3. Protection of equipment, fittings and accessories shall be provided throughout the painting operations. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other Work from all damage during the operation and until the finished job is accepted.
4. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally

furnished by the manufacturer shall cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, 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.

5. All safety equipment shall be painted in accordance with OSHA Standards as approved.
6. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint.
7. Only skilled painters shall be used on the Work and specialists shall be employed where required.
8. Work shall be done in a safe and workmanlike manner.

B. Field Priming:

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule.
2. Equipment which is customarily shipped with a baked-on enamel finish or with a standard factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coats or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish.

C. Field Painting:

1. All painting at the site shall be designated as Field Painting.
2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 50 degrees F., in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.
3. Successive coats of paint shall be tinted so as to make each coat easily distinguishable from each other with the final undercoat tinted to the approximate shade of the finished coat.
4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with No. 00 sandpaper or equal to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted and all exterior trim shall be back-primed before installation.
5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. All exterior concrete and masonry paint shall be performed at one continuous manner structure by structure. Materials subject to weathering shall be

- prime coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.
6. All materials shall be brush painted unless spray painting is specifically approved by the Engineer.
  7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.
  8. Before final acceptance of the Work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.
  9. The aluminum Work noted on the Drawings or in the Painting Schedule except all structural walkways, supports, railings, toeboards, grating and checkered plate shall be field painted.
  10. Any pipe scheduled to be painted and having received a coating of tar or asphalt-compound shall be painted with two coats or equal before successive coats are applied per the schedule.

### 3.04 CLEANUP

- A. The premises shall at all times be kept free from accumulation of waste material and rubbish caused by employees or Work. At the completion of the painting remove all tools, scaffolding, surplus materials, and all rubbish from and about the buildings and leave Work "broom clean" unless more exactly specified.
- B. Upon completion, remove all paint where it has been spilled, splashed, or splattered on all surfaces, including floors, fixtures, equipment, furniture, etc., leaving the Work ready for inspection.

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## **SECTION 09905**

### **PIPING, VALVE, AND EQUIPMENT IDENTIFICATION SYSTEM**

#### **PART 1 – GENERAL**

##### **1.01 DESCRIPTION**

- A. Scope of Work: The work included under this Section consists of providing an identification system for piping systems and related equipment.
- B. Related Work Described Elsewhere:
  - 1. Submittals: Section 01300.
  - 2. Painting: Section 09900.
  - 3. Equipment: Division 11
  - 4. Mechanical: Division 15.
  - 5. Electrical: Division 16.

##### **1.02 QUALITY ASSURANCE**

- A. Standards: 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 in accordance with Section 01300.
- 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 of 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 PRODUCTS DELIVERY, STORAGE, AND HANDLING**

- A. Delivery of Materials: Except for locally mixed custom colors, deliver sealed containers with labels legible and intact.
- B. Storage of Materials:
  - 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.

## 1.05 JOB CONDITIONS

- A. Environmental Requirements:
  1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
  2. Do not apply finish in areas where dust is being generated.
- B. Protection: Cover or otherwise protect finished work of other trades and surfaces not to be painted.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. Materials for painting shall conform to the requirements of Section 09900: Painting.
- B. Materials selected for coating systems for each type surface shall be the product of a single manufacturer.
- C. Aboveground piping shall be identified by self-adhesive pipe markers equal to those manufactured by W. H. Brady Company or approved equal.
  1. Markers shall be of wording and color as shown in Table 09905-A.
  2. Lettering shall be:
    - a. 2¼-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. 2¼-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.
- D. Buried piping shall be identified by identification tape installed over the centerline of the pipelines.
  1. Identification Tape for Steel or Iron Pipe: Identification tape shall be manufactured of inert polyethylene film so as to be highly resistant to alkalies, acids, or other destructive agents found in soil, and shall have a minimum thickness of 4 mils. Tape width shall be 6 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every 2 feet for entire length of tape. Tape shall be Terra Tape Standard 250, or approved equal.
  2. Identification Tape for Plastic or Non-Magnetic Pipe: Identification tape shall be manufactured of reinforced polyethylene film with a minimum overall thickness of 4 mils and shall have a 0.35 mil thick magnetic metallic foil core. The tape shall be highly resistant to alkalies, acids, and other destructive agents found in soil. Tape width shall be 3 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a

minimum of once every 2 feet for entire length of tape. Tape shall be TerraTape Sentry Line 1350, or approved equal.

3. Tape background colors and imprints shall be as follows:

<u>Imprint</u>	<u>Background Color</u>
"Caution Sewer Line Buried Below"	Green
"Caution Electrical Line Buried Below"	Red
"Caution Water Line Buried Below"	Blue
"Caution Telephone Line Buried Below"	Orange
"Caution Reuse Line Buried Below"	Purple
"Caution Compressed Air Line Buried Below"	Dark Green
"Caution Chemical Line Buried Below"	Yellow

4. Identification tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, TX; Allen Systems, Inc., Wheaton, IL; or approved equal.

E. Locating Wire:

1. All buried pipe shall be installed with insulated locating wiring capable of detection by a cable locator and shall be wrapped with nylon straps to top centerline of the pipe.
2. Locating wire shall be 10 gauge solid copper, continuous with no splices, and be color-coded to match the utility installed.

F. Aboveground Valve Identifications: A coded and numbered tag attached with brass chain and/or brass "S" hooks shall be provided on all valves.

1. Tag Types: Tags for valves on pipe shall be brass or anodized aluminum. Colors for aluminum tags shall, where possible, match the color code of the pipe line on which it is installed. Square tags shall be used to indicate normally closed valves and round tags shall indicate normally open valves.
2. Coding: 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-A, 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.

G. 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 or stainless steel disc embedded in the surface as shown on the Drawings. The 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 Services – See Table 09905-A for abbreviations.
4. Direction to open and number of turns to fully open.

## **PART 3 – EXECUTION**

### **3.01 COLOR CODING FOR PIPES AND EQUIPMENT**

- A. Piping color codes and code labels for pipe identification shall conform to Table 09905-A.
- B. General Notes and Guidelines:
  - 1. Pipelines, equipment, or other items that are not listed here shall be assigned a color by the Owner and shall be treated as an integral part of the Contract.
  - 2. 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 system.
  - 3. All moving parts, drive assemblies, and covers for moving parts that are potential hazards shall be Safety Orange.
  - 4. All safety equipment shall be painted in accordance with OSHA Standards.
  - 5. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. 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.
  - 6. All pipe hangers and pipe supports shall be painted, unless specified otherwise due to material of construction.
- C. All pipe hangers, pipe supports, and accessories 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 hangers 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 09900.
- D. All systems that 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.
- E. All insulated surfaces, unless otherwise specified, shall be given one (1) coat of sizing, one (1) prime coat, and one (1) finish coat.

F. System code lettering and arrows shall conform to the requirements of ANSI A 13.1 marked on piping as follows:

1. 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
	Orange
	Black
(S) Safe:                    Green	Black
	White
	Black
	White
	Light Gray
	Black
	Dark Gray
	White
	Aluminum
	Black
(P) Protective:            Blue	White

2. All piping containing or transporting corrosive or hazardous chemicals shall be identified with labels every 10 feet and with at least two (2) labels in each room. Otherwise, markers shall be placed no more than 20 feet apart with at least one (1) marker on every straight run and additional markers at turns and where pipes pass through walls.

3. An arrow indicating direction of flow shall be placed adjacent to each marker.

### 3.02 FABRICATED EQUIPMENT

A. Unless otherwise indicated or specifically approved, all fabricated equipment shall be shop primed and finished. See Section 09900: Painting.

B. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage.

C. Where specified in other Sections of these Specifications for mechanical equipment, the Contractor shall apply field coats of paint in accordance with Section 09900. If the shop finish coating 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.

3.03 INSTALLATION OF IDENTIFICATION TAPE

- A. Identification tape shall be installed for all buried pipelines and conduits in accordance with the manufacturer's installation instructions and as specified herein.
- B. Identification tape for piping shall be installed at two (2) locations:
  - 1. One (1) foot below finished grade along centerline of pipe, and;
  - 2. Directly on top of the pipe.

**TABLE 09905-A  
COLOR CODES AND ABBREVIATIONS**

<b>Service</b>	<b>Mark</b>	<b>Conduit, Pipe, and Valve Color Code</b>	<b>Letter and Flow Arrow Color</b>
Sodium Hypochlorite	C	Yellow	Black
Hydrofluorosilicic Acid	F	Light Blue with Red Band	Black
Drain	DR	Dark Gray	White
Water Main	WM	Dark Blue	White
Sample Line	SA	Gray	Black

- 1. Note: Yellow shall be the Tnemec Series 1028 (Gloss) – Canary Yellow (14YW). Dark Blue shall be Tnemec Series 1028 (Gloss) Purple Haze (12SF). The Owner will provide color selection for all other colors.

END OF SECTION

## **SECTION 10400**

### **SIGNAGE**

#### **PART 1 – GENERAL**

##### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Interior signage
  - 2. Plastic safety signs.
  - 3. Hazardous Chemical Storage signs for tanks and building.
  - 4. Safety Shower and Eyewash signs.

##### **1.02 SUBMITTALS**

- A. Product data sheets for each item specified.
- B. Samples:
  - 1. Interior room number and name signs.
  - 2. Color sample chart for each type of sign indicated.
- C. Provide a comprehensive list of all room names and numbers for each building space as well as quantities and locations for all other signs specified.

##### **1.03 QUALITY ASSURANCE**

- A. Each door to each occupied space shall have a room sign installed.
- B. All room signage and life safety signage shall be in Braille per the Florida Building code, 423.14.

##### **1.04 FLORIDA ACCESSIBILITY CODE FOR BUILDING CONSTRUCTION**

- A. Signage shall conform with the Accessibility Requirements Manual from the Florida Department of Community Affairs, Florida Board of Building Codes and Standards.

#### **PART 2 – PRODUCTS**

##### **2.01 MANUFACTURER**

- A. Interior identifying devices and exterior building letters shall be as manufactured by one of the following:
  - 1. Rick's Quality Printing & Signs
  - 2. Vital Signs of Orlando, Inc.
  - 3. Sign Design of Florida, Inc.

4. Environmental Graphics, Inc.
5. Innerface Architectural Signage
6. Commercial Signs & Graphics
7. Signs Plus
8. APCO Graphics, Inc.
9. ASI Sign Systems
10. Best Sign Systems

B. Safety Signage: Provide signs similar to MySafetySign.com.

## 2.02 INTERIOR SIGNAGE

A. Basis of Design: IM System, RI-66-A by APCO.

B. General:

1. Graphic Process: Raised letters and Braille, formed as an integral part of the sign face.
2. Size: 6 inches by 6 inches with radius corners.
3. Mechanically fastened.
4. Colors: Letters and background colors as selected by Architect from manufacturer's standard colors.
5. Letters: Letters and numbers shall have width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 and 1:10. Letters and numbers shall be raised 1/32-inch, uppercase, sans serif or simple sans serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be 5/8-inch high minimum and 2 inches high maximum.
6. Characters and backgrounds must be eggshell, matte, or other non-glazed surface.

C. Capacity signs for all rooms with a capacity of 49 persons or more.

1. Provide capacity signs reading "MAXIMUM CAPACITY."
2. Provide at least two signs per room.

D. Maximum Occupancy Signage: Signs reading "MAXIMUM OCCUPANCY xx."

E. Toilet Room Accessibility Signs: Provide one sign depicting International Men/Women Symbol at each accessible toilet room.

F. Interior Room Name and Number Signs: Layout of room name and number shall be as directed by the Architect.

1. Layout of room name and number shall be as directed by the Architect.

G. Storage Signs: Provide at electrical, mechanical, kiln room, and fire riser rooms to read NO STORAGE ALLOWED.



- H. Evacuation signage:
  - 1. Provide evacuation signs indicating a graphic diagram of primary and secondary evacuation routes posted inside, adjacent to the primary exit door. Provide at all room with occupancy of 6 or greater.
  - 2. Colors: Black building plan on white background with evacuation route in red.
- I. Safety Sign:
  - 1. Plastic sheet with printed message.
  - 2. Refer to Owner for exact text of each sign.
  - 3. Mounting: Tamperproof 316 stainless steel screws and bolts for substrate intended.
- J. Hazardous Chemical Warning Signs:
  - 1. Door-mounted hazardous warning signs shall be provided for each door for chemical supply/feed room.
  - 2. Wall-mounted or post mounted warning signs shall be provided for each chemical or fuel fill station.
  - 3. Tank mounted warnings signs shall be provided for each chemical storage tank.
  - 4. Hazardous warning signs shall be diamond-shaped with four color quadrants conforming to NFPA 704. These signs shall be 10-inch square overall size and shall be equivalent to Seton Name Plate Co. "Metal-backed butyrate (BMB)".

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Mount interior signage with concealed mechanical fasteners recommended by manufacturer. Safety signage to be screwed at each corner.
- C. Provide mounting and installation kits for mounting building letters.
- D. Install interior signage in accordance with approved shop drawings, Accessibility Requirements Manual from the Florida Department of Community Affairs.
- E. Secure Work true to line and level. Allow for building expansion.
- F. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.
- G. Isolate incompatible material as necessary to prevent deterioration.
- H. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the

particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

1. Mounting Height: Mount accessible signage at 60-inches above finished floor to the center line of the sign.

END OF SECTION

**SECTION 13121**  
**PREFABRICATED STEEL BUILDINGS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Contractor shall furnish all labor, materials, equipment, and incidentals as required for the provision and proper installation of pre-engineered, prefabricated steel structure for a permanent guardhouse as shown on the Drawings and specified herein.
- B. The building manufacturer shall supply plans and calculations which shall be stamped by a Registered Professional Engineer for the State of Florida and shall be responsible for obtaining all building permits and certificates of occupancy required for the guardhouse. The building manufacturer shall be responsible for obtaining any state building approvals and third party inspections if required by the State of Florida or local municipality.
- C. All anchor bolts, gaskets, sealants, and other accessories and appurtenances, required for a complete and operating installations shall be included whether specifically mentioned or not.

**1.02 QUALITY ASSURANCE**

- A. All pre-engineered steel structures shall be supplied by an experienced firm who has continually engaged in the manufacture and/or fabrication of portable steel structures, shelters and enclosures. Firms not listed in this specification must clearly document a minimum of five (5) years experience with similar projects of equal scope of design.
- B. Contractor shall assure that all field dimensions are taken accurately and communicated properly to the manufacturer, that other trades will not affect a proper installation of the steel structure, and that all manufacturer's instructions and recommendations are followed.
- C. The manufacturer shall maintain a continuous quality control program and upon request shall furnish to the engineer design drawings and/or calculations, applicable certifications, catalog information, and color samples.

**1.03 SYSTEM DESCRIPTION**

- A. Factory-fabricated, pre-engineered structures shall be designed to withstand the wind load as defined on the drawings and direct exposure for outdoor installation.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. All equipment and parts must be properly protected against any damage during a prolonged period during delivery and at the site as specified.
- B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- C. The building manufacturer shall provide the spreader bars, and any onsite rigging, from the spreader bars to the building base required for offloading, and placement of the station in the final position on the concrete foundation/pad at the job site.

#### 1.05 SHOP DRAWINGS AND SUBMITTALS

- A. Submit complete shop drawings and product data for all prefabricated steel structures as required by this scope of work
- B. Submittal shall include elevations, section, floor plan, electric schedule, service entrance locations, and anchor clip detail.
- C. Submit design drawings that are prepared, signed, and sealed by a Florida licensed professional engineer/architect and a complete set of design calculations for the building in conformance with ASCE 7, which shall be signed and sealed by a Florida Registered Professional Engineer. Design drawings and calculations shall meet or exceed Florida Building Code requirements.
- D. Shop drawings shall show all materials as required and include all dimensions, connections, fasteners, structural supports, adjustments, openings, anchors, tolerances, assembly and installation details as required, including:
  - 1. Manufacturer's standard details and catalog.
  - 2. Data demonstrating compliance with referenced standards.
  - 3. Installation instructions and manufacturer certification that materials comply with specified requirements and are suitable for the intended application.
  - 4. Warranty documents.

### **PART 2 – PRODUCTS**

#### 2.01 GENERAL

- A. Building shall be of welded steel construction with all intersecting welded connections ground smooth. Overall height shall be as indicated on the drawings. Model number to be Durasteel PC-108SL as manufactured by Porta-King Building Systems.
- B. Structural corners and uprights to be 3"x3"x.120 structural ASTM A500 Grade B welded tubing.

C. Building shall be weather proof and air-conditioned.

## 2.02 COMPONENTS

### A. Wall and Ceiling Panels:

1. Wall panels shall be 14 gauge galvanized steel on exterior and 16 gauge galvanized steel on interior. Wall panels to be mechanically fastened to framework to allow field replacement of damaged panels. Overall wall thickness shall be 3-inch.
2. Provide R-13 wall insulation and R-19 ceiling insulation.
3. Ceiling to be a steel finished composite panel, painted to match total building.

### B. Finish:

1. All interior and exterior surfaces shall be electrostatically painted with rust inhibitive epoxy primer and shall have a finish coat of air-dry industrial acrylic paint.
2. Interior and exterior surfaces shall be painted with a color approved by the Owner.
3. Panic: Provide doors with panic stainless steel hardware.

### C. Floor Structure:

1. Floor structure to be an integral part of the building with 1-1/2" solid waterproof insulating core fit tight against panels and fastened to bottom structural base frame. Shall meet Florida Building Code requirements.
2. Provide R-12 floor insulation.
3. Finished floor shall be maintenance-free aluminum treadplate floor covering.

### D. Doors:

1. Doors to be of anodized aluminum 1-3/4" tubular construction and half-glazed. Bottom portion to include smooth anodized aluminum panel finish.
2. Sliding door to be ceiling suspended in overhead track assembly and shall be fully weather-stripped.
3. Doors shall be fitted with keyed entry high security locks.

### E. Windows and Glazing:

1. Windows shall have anodized aluminum frames and inserts and to be industrial quality.
2. Windows shall be glazed with 5/8" tinted, insulated, tempered safety glass.
3. Two windows shall be active window panel to slide horizontally on stainless steel, ball-bearing rollers to facilitate communication with drivers
4. Windows shall include inside positive locking device.
5. Exterior window sill height to be 38" (inside sill height 34" from finished floor).

F. Counter:

1. Furnish 22" deep, full-width painted steel counter, 32" a.f.f.
2. Counter shall have two, 2" openings.

G. Electrical:

1. Power to the building shall be furnished from the existing service at the treatment facility.
2. Electrical service to include one (1) three phase, 100 amp 120/208 volts, 3 phase, 4 wire load center with 40 ampere main breaker, prewired in conduit, with one 208v circuit and four 20 ampere 115v circuit capacity.
3. Provide two spare 20A branch circuit breakers.
4. Provide one – 115v duplex outlet and one-208v outlet.
5. Conduits and electrical boxes and fixtures to be surface mounted.
6. All electric work shall be in compliance with the National Electrical Code. All electrical components shall bear the UL label.
7. Lights to be T-8 fluorescent type fixture with acrylic lens and wall switch. Insulation value: R-14
8. Battery-operated emergency lighting will be installed inside the building. Backup power will be provided by the plant generator.
9. Include one thru-wall HVAC unit (208v, 11,600C/11,600H BTU).
10. Provide empty conduit runs with pull wire to run communication lines.

H. Exterior Roof:

1. Provide a standing seam metal galvalumed pitched roof with 6" overhang, 6" high fascia and gutters.
2. Roof color shall be approved by the Owner.

- I. The building design shall be provided by the pre-engineering company per the provided notes.

## **PART 3 – EXECUTION**

### **3.01 INSPECTION**

- A. Upon receipt of material at job site, the Contractor shall inspect all materials for shipping damage. Any damage is to be noted on the shipping receipt/packing list and reported promptly to the shipper.

### **3.02 INSTALLATION**

- A. Installing contractor to coordinate and verify that other construction trades and materials have been installed per the contract drawings, and, that they are accurate in location, alignment, elevation, and are plumb and level.

- B. Install prefabricated building on a flat and level concrete pad in accordance with the manufacturer's installation drawings and instructions supplied by the manufacturer/supplier.
- C. Install materials accurately in location and elevation, level, and plumb. Field fabricate as necessary for accurate fit. Verify that concrete is level and true to plane and of correct dimensions to receive structure. Correct any deficiencies before proceeding.
- D. Contractor to determine and specify anchor tabs, as required to meet Florida Building Code requirements. Layout anchor bolt pattern according to manufacturer's drawings.
- E. Erect structures true to line and plumb, free of twist and warp.
- F. Install and test accessories in accordance with manufacturer's instructions.
- G. Adjust components for proper operation.

END OF SECTION

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**SECTION 13300**  
**INSTRUMENTATION AND CONTROLS**

**PART 1 – GENERAL**

1.01 SUMMARY

- A. The Contractor shall furnish, install and place into service operating process instrumentation, control systems and panels including accessories, related to this facility, all as shown on plans and specified herein.
1. Existing plant systems must remain operational during construction, unless approved by the Owner and Engineer. Nighttime and/or other off hours work may be required to support plant operations and shall be included in the Contractor's bid.
  2. The instrument contractor is responsible to "As-Built" all existing control panels and to provide all demolition and modification as necessary for the installation of the new I/O in the existing local control panels.
  3. Equipment rendered obsolete by this contract must be removed from the existing panels. Equipment previously abandoned must also be removed from the panels. Functioning equipment present in these panels must remain functional and will be included on the instrument contractor's "As-Built" drawings. No existing equipment, with the exception of the field wires and panel, may be reused as part of the new control system. New power supplies, surge suppressors, terminal strips, etc. for all I/O to be connected to the new control system must be provided new. The instrument contractor is responsible to provide completed panels that are clean, functional and present a professional appearance.
  4. All new wires in control panels must be permanently tagged and shown on the as-built drawings. This includes all spare and abandoned wires and cables. Spare and abandoned cables are to be taped and left coiled in the panels for future use. Cable and wire numbers are to be assigned by the contractor, documented and controlled to prevent duplicate numbers. The Contractor shall turn over to the owner, at the project conclusion, a cable and wire list showing assigned numbers and their physical location in the plant.
  5. See electrical drawings and specifications for additional work required of the instrument contractor as part of this project to supply demolition instructions, relocation and modification instructions for equipment not necessarily shown on the instrument drawings.
  6. Contractor's Integrator shall modify the existing PLC system/program, SCADA screens, and Report generation requirements at the existing Eastern Regional Plant – Control room and local plant.
  7. Contractor shall provide travel expenses for FAT period as stated in section 3.01.B.
  8. All instruments and control devices and installation shall comply with Orange County Utilities standard documents as applicable.

9. Preliminary and critical software design review meeting shall be conducted by the software engineer/Contractor with Owner and Engineer to insure design compliance with all specification hardware and software requirements as well as the discussion of the preliminary control strategy of the system.
- B. Work Includes: Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owner training for a complete Instrumentation and Control System. Major parts are:
1. Instrumentation including primary elements, transmitters, and control devices.
  2. Control Panel Modifications.
  3. PLC and I/O Rack Control Panels Modifications.
  4. Software Modifications.
  5. Acceptance Testing, including 30-day system acceptance test.
- C. Instrument and Control (I&C) Supplier work scope:
1. For I&C equipment and ancillaries provide the following:
    - a. Completing detail design.
    - b. Required Submittals.
    - c. Equipment and ancillaries.
    - d. Instructions, details, and recommendations to, and coordination with, Contractor for proper installation.
    - e. Verify readiness for operation.
    - f. Verify the correctness of final power and signal connections.
    - g. Adjusting and calibrating.
    - h. Starting up.
    - i. Testing and coordination of testing.
    - j. Training.
  2. Verify following work not by I&C Supplier is provided:
    - a. Correct type, size, and number of signal wires with their raceways.
    - b. Correct electrical power circuits and raceways.
    - c. Correct size, type, and number of I&C related pipes, valves, fittings, and tubes.
    - d. Correct size, type, materials, and connection of process mechanical piping for in-line primary elements.
  3. For equipment not provided under I&C Supplier, but directly connected to equipment required by I&C Supplier:
    - a. Obtain from Contractor, manufacturer's information on installation, interface, function, and adjustment.
    - b. Coordinate with Contractor to allow required interface and operation with I&C System.
    - c. For operation and control, verify that installations, interfacing signal terminations, and adjustments have been completed with manufacturer's recommendations.
    - d. Test to demonstrate required interface and operation with I&C System.
    - e. Examples of items in this category, but not limited to the following:
      - 1) Valve operators, position switches, and controls.
      - 2) Chemical feed pump and feeder speed/stroke controls.
      - 3) Automatic samplers.
      - 4) Motor control centers.

- 5) Adjustable speed drive systems.
  - f. Examples of items not in this category:
    - 1) Internal portions of equipment provided under Division 16, Electrical, that are not directly connected to equipment under I&C System.
    - 2) Internal portions of I&C Systems provided as part of package systems and that are not directly connected to equipment provided under I&C System.
  - 4. Wiring external to equipment provided by I&C Supplier:
    - a. Special control and communications cable: Provided by I&C Supplier.
  - 5. Signal Verification
    - a. All proposed and existing control signals shall be verified from field device to the Eastern Regional control room for accuracy and scaling.
    - b. Furnish testing form to document each signal. Each form shall be signed and sealed by a Florida Registered Professional Engineer
- D. Software Engineering work scope:
- 1. Configuration of PLCs, including:
    - a. Correct I/O mapping and scaling.
    - b. Ladder logic implementing defined control strategies.
    - c. SCADA interface mappings.
    - d. Specifications/documents including: System External Specification, System Internal Specification, I/O Checklist, Factory Acceptance Test Plan, and Site Acceptance Test Plan.
    - e. As-built documentation
  - 2. Start-up support, including system testing.
  - 3. System training.
  - 4. Computer-based SCADA system (Proficy iFIX SCADA). Coordinate with Owner for software version requirements and match the current version installed at Eastern Regional Plant. I&C Supplier shall update the graphics, database, and historical reports at the Eastern Regional to support the monitoring and operation of theWSFs.

## 1.02 SINGLE INSTRUMENT SUPPLIER

- A. The Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The Contractor shall have said supplier perform all engineering necessary in order to select, to furnish, to program, to supervise installation, connection, to calibrate, to place into operation of all sensors, instruments, alarm equipment, control panels, accessories, and all other equipment as specified herein. The I&C supplier shall have a maintenance repair facility within a 150 mile radius of the project.
- B. The single instrument and controls supplier shall demonstrate his or her ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: system engineering, documentation including panel assembly, schematics and wiring diagram, programming, field testing, calibration and start-up, operator instruction and maintenance training.

The foregoing shall enable the Contractor and the Owner to be assured that the full responsibility for the requirements of this Section shall reside in an organization which is qualified and experienced in the water management field and its process technology on a functional systems basis.

The single I&C supplier shall have a UL approved shop and shall build all panels according to UL 508A.

Instrumentation and Controls supplier shall be **Curry Controls**.

- C. The single software engineering supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: ladder logic programming, computer-based SCADA system configuration, documentation, field testing, start-up, and operator instruction.

### 1.03 INSTALLATION WORK

- A. Nothing in this part of the Specifications shall be construed as requiring the Contractor to utilize personnel supplied by his or her assigned instrument manufacturer's organization, or any division thereof, to accomplish the physical installation of any elements, instruments, accessories or assemblies specified herein. However, the Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories and assemblies; portions of their work shall be supervised or checked as specified in Part 3, herein.

### 1.04 PREPARATION OF SUBMITTAL OF DRAWINGS AND DATA

- A. It is incumbent upon the Contractor to coordinate the work specified in these Sections so that a complete I&C system for the facility shall be provided and shall be supported by accurate Shop and record Drawings. As a part of the responsibility as assigned by the Contractor, the Single I&C supplier shall prepare and submit through the Contractor, complete organized Shop Drawings, as specified in Part 2.02, herein. Interface between instruments, motor starters, etc. shall be included in his Shop Drawing submittal.
- B. During the period of preparation of this submittal, the Contractor shall authorize direct, informal liaison between his or her Single I&C supplier and the Engineer for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as specified may be authorized informally by the Engineer, but these shall not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to or variation from these Specifications.
- C. In addition, I&C supplier/programmer shall also provide fully documented version of PLC programming and HMI programming on the CD.

#### 1.05 ADDITIONAL TECHNICAL SERVICES

- A. At no separate additional cost to the Owner, the Contractor shall provide the following services of qualified technical representatives of the Single I&C supplier (See Part 3, herein).
  - 1. To supervise installation and connection of all instruments, elements, and components of every system, including connection of instrument signals to primary measurement elements and to final control elements such as pumps, valves, and chemical feeders;
  - 2. To make all necessary adjustments, calibrations and tests; and
  - 3. To instruct plant operating and maintenance personnel on instrumentation. This time shall be in addition to whatever time is required for other facets of work at the site, and shall be during the Owner's normal working days and hours.

#### 1.06 GUARANTEE

- A. The Contractor shall guarantee all equipment and installation, as specified herein, for a period of two (2) years following the date of completion of the work. To fulfill this obligation, the Contractor shall utilize technical service personnel designated by the Single I&C supplier to which the Contractor originally assigned project responsibility for instrumentation. Services shall be performed within four (4) hours after notification by the Owner.

#### 1.07 ADDITIONAL PROVISIONS

- A. The applicable provisions of the following Sections under Electrical Work shall apply to work and equipment specified herein, the same as if stated in full, herein:
  - 1. Codes and Standards
  - 2. Equipment, Materials and Workmanship
  - 3. Testing
  - 4. Grounding
  - 5. Equipment Anchoring
  - 6. Conductor and Equipment Identification
  - 7. Terminal Cabinets and Control Compartments
  - 8. Process Control Devices

#### 1.08 NEWEST MODEL COMPONENTS

- A. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of Shop Drawings unless otherwise specified to match existing equipment. All technical data publications included with submittals shall be the most recent issue.

#### 1.09 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The instrumentation drawings were developed from past record drawings and information supplied by the Owner.

- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and instrumentation and control systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the Contractor's failure to fulfill this requirement.

#### 1.10 RELATED WORK

- A. Division 16: Electrical.
- B. Division 11: Equipment.
- C. Division 13: Special Construction.

### **PART 2 – PRODUCTS**

#### 2.01 INSTRUMENTATION CRITERIA

- A. Designation of Components: In these Specifications and on the Drawings, all systems, meters, instruments, and other elements are represented schematically, and are designated by numbers, as derived from criteria in Instrument Society of Automation Standard ANSI/ISA S5.1-1973. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, data sheets, and similar materials. Any other symbols, designations, and nomenclature unique to the manufacturer's standard methods shall not replace these prescribed above, used, herein and on the Drawings.
- B. Signal Characteristics: Signals shall be electrical, as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control panel(s) shall be 4 to 20 milliamperes DC, except as noted. Signals within enclosures may be 1-5 volts DC.
- C. Matching Style, Appearance And Type: All instruments to be panel mounted at the control panels shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one (1) manufacturer.
- D. Accuracy And Repeatability: The overall accuracy of each instrumentation system or loop shall be as prescribed in the Specifications for that system or loop. Each system's accuracy shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracy s" of certain designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual electronic instrument shall have a minimum accuracy of  $\pm 0.7$  percent of full scale and a minimum repeatability of  $\pm 0.4$  percent of full scale unless otherwise specified. Instruments which do not conform to or improve upon these criteria are not acceptable.

- E. Signal Isolators, Converters And Power Supplies: Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to insure adjacent component impedance match or where feedback paths may be generated. Signal converters shall be included where required to resolve any signal level incompatibilities. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to insure sufficient power to each loop component.
- F. Alternative Equipment Or Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior approval of the Engineer. Any changes inherent to a proposal alternative shall be at no additional cost to the Owner. The required approval shall be obtained in writing by the I&C Subcontractor through the Contractor prior to submittal of Shop Drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method specified, or shall include evidence that a specified component is not available. Otherwise, alternative equipment (other than direct, equivalent substitutions) and alternative methods shall not be proposed.

## 2.02 DETAILED SYSTEMS DRAWINGS AND DATA

- A. Content: The Contractor shall submit detailed Shop Drawings and data prepared and organized by the Single I&C supplier designated at the time of bidding. The quantity of submittal sets required shall be six (6). These Drawings and data shall be submitted as a complete bound package at one time within 80 calendar days after date of Notice to Proceed and shall include:
  - 1. Drawings showing definite diagrams for every instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ISA Standard S5.4, each having the format of ISA Standard S5.1 as used on the Project Drawing. (Each system or loop diagram shall be drawn on a separate Drawing sheet.)
  - 2. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:
    - a. Component function description used herein and on the Drawings;
    - b. Manufacturer's model number or other product designation;
    - c. Project tag number used herein and on the Drawings;
    - d. Project system loop of which the component is a part;
    - e. Project location or assembly at which the component is to be installed;
    - f. Input and output characteristics;
    - g. Scale range and units (if any) and multiplier (if any);
    - h. Requirements for electric supply (if any);
    - i. Requirements for air supply (if any);
    - j. Materials of component parts to be in contact with, or otherwise exposed to, process media;
    - k. Calibration curves as required;
    - l. Special requirements or features.

- A complete index shall appear in the front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.
3. Drawings showing both schematic and wiring diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each control panel shall be submitted first, using schematic control diagrams. Subsequent to return of this first submittal by the Engineer, piping and wiring diagrams shall be prepared and submitted for review by the Engineer; the diagrams shall consist of component layout Drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as samplers, pumps, valves, and chemical feeders. The Contractor shall furnish all necessary equipment supplier's Shop Drawings to facilitate inclusion of this information by the I&C system supplier. Schematic and wiring diagram criteria shall be followed as established in NEMA Standards Publication ANSI/NEMA ICS-1-1978, "Industrial Control and Systems."
  4. Assembly and construction Drawings for each control panel and for other special enclosed assemblies for field installation. These Drawings shall include dimensions, identification of all components, surface preparation and finish data, nameplates, and the like. These Drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
  5. Installation, mounting and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.
  6. Complete and detailed bills of materials. A master Bill of Materials listing all field mounted devices, control panels and other equipment that shall be shipped to the job site. A Bill of Materials for each control panel listing all devices within the panel.
  7. Modifications to existing equipment. A complete description of all proposed modifications to existing instrumentation equipment, control panels, control devices, cabinets, etc., shall be submitted with the Shop Drawings complete with detailed Drawings of the proposed modifications.
- B. Organization And Binding: The organization of initial Shop Drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting "as built" conditions. Accordingly, the initial multiple-copy Shop Drawing submittal shall be separately bound in 3-ring binders of the type specified under Part 2.03, herein, for the Technical Manuals.



## 2.03 TECHNICAL MANUALS

- A. Five (5) final sets of technical manuals shall be supplied for the Owner, and one (1) final set shall be supplied for the Engineer, as a condition of acceptance of the project. Each set shall consist of one (1) or more volumes, each of which shall be bound in a standard size, three-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3.0 inches.
- B. Initially, two (2) sets of these manuals shall be submitted to the Engineer for favorable review after return of favorably reviewed Shop Drawings and data required under Part 3, herein. Following the Engineer's review, one (1) set shall be returned to the Contractor with comments. The sets shall be revised and/or amended as required and the requisite final sets shall be submitted to the Engineer fifteen (15) days prior to start-up of systems. The Engineer shall distribute the copies.
- C. In addition to updated Shop Drawing information to reflect actual existing conditions, each set of technical manuals shall include installation, connection, operating, troubleshooting, maintenance, and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance, and repair. Exploded or other detailed views of all instruments, assemblies, and accessory components shall be included together with complete parts lists and ordering instructions.

## 2.04 SPARE PARTS

- A. The Contractor shall include, as part of the bid package, a list of recommended spare parts covering items required under Section 13300 except PLC's of these Specifications. The total price of these spare parts shall not be less than \$5,000.00 and this sum shall be a part of the Contractor's total bid price. PLC spare parts are covered in the PLC section of this Specification, and the \$5,000.00 cited above shall be in excess of the PLC spare parts as listed in 2.08 this specification. The Single I&C Supplier in fact shall be responsible for delivery of the spare parts, as directed by the Owner after plant start-up. Prior to delivery of the spare parts, the Owner shall have the option of adding or exchanging any originally enumerated component based on current list prices for each item. The Contractor shall also submit a list of recommended equipment for maintaining and calibrating equipment furnished under Section 13300.
- B. The Single I&C supplier in fact shall be responsible for delivery of the spare parts, as directed by the Owner either during or after start-up. Prior to delivery of the spare parts, the Owner shall have the option of adding or exchanging any originally enumerated component based on current list prices for each item.

## 2.05 CONTROL PANELS

- A. General: Control panels shall be modified to include the following:
  - 1. Bent Oaks
    - a. GSR Fill valve testing and integration into SCADA system

2. Oak Meadows
  - a. Deleting generator vibration switch alarm.
  - b. Testing reconnected existing equipment. Generator, starters, ATS
  - c. Integrate new starter trouble signals using spare I/O.
  - d. Integrate digital interface of generator
  - e. Test all automation and confirm existing controls are unaffected by this new work.
3. New drives at Western Regional

B. Signal And Control Circuit Wiring:

1. Wire Type and Sizes: Conductors shall be flexible stranded copper wire; these shall be U.L. listed Type THHN and shall be rated 600 volts. Wire for control signal circuits and alarm input circuits shall be 16 AWG. All instrumentation cables shall be shielded No. 20 AWG with a copper drain wire. All special instrumentation cable such as between sensor and transmitter shall be supplied by the I&C supplier.
2. Wire Insulation Colors: Conductors supplying 120 volt AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 volt AC control circuit conductors shall be red. All wires energized by a voltage source external to the control board(s) shall have yellow insulation. Insulation for all DC conductors shall be blue.
3. Wiring Installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel mounted components. Wiring run from components on a swing-out panels to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at terminals. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts. Wiring to rear terminals on panel mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments. Shields of shielded instrument cable shall only be grounded on one side of each cable run. The side to be grounded shall always be in the field as applicable. Care shall be exercised to properly insulate the ungrounded side, to prevent ground loops from occurring. Conformance to the above wiring installation requirements shall be reflected by details shown on the Shop Drawings for the Engineer's review.
4. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all Shop Drawings. These numbers shall be marked on all conductors at every terminal using permanently marked heat-shrink plastic. Instrument signal circuit conductors shall be tagged with unique multiple digit numbers. Black and white wires from the circuit breaker panelboard shall be tagged including the one (1) or two (2) digit number of the branch circuit breaker and panel number.

5. Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be General Electric Type CR 151A1 with mounting rack, equivalent by Cinch-Jones or equal.

- C. PLC Control Panel Requirements: All input/output hardware and interface equipment shall be provided by the computer & PLC system supplier for all specified inputs and outputs. Input/output hardware shall be plug-in modules (or equivalent I/O assembly and associated printed circuit board) in associated I/O rack assemblies.

Signal and control circuitry to individual input/output modules shall be arranged such that any one module failure shall not disable more than one control loop within any group of controlled equipment (eg. one pump out of a group of three pumps, etc.) The latest revision of the programming software shall be installed as of substantial completion.

All analog and discrete inputs and outputs shall be optically or transformer isolated for voltage surge protection and shall meet peak common mode and 3 kV surge to ground withstand capability (SWC) test as specified by ANSI C37.90A197A (IEEE Standard 472-1974).

In the event a standard manufacturers product does not satisfy the above surge requirements, additional protective circuitry to suppress contact bounce and to protect transients from being recognized as data. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms which are movable to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. PLC shall be a standard Quantum using ladder logic and NOE module. Latest firmware shall be installed on the processor. Input/output modules shall have individual indicators that show the on/off status of each input or output device connected to it.

1. Analog Input: The analog input subsystem shall accept 4-20 MA (1-5 volts across 250 ohms) signals which shall be multiplexed into one or more amplifiers and ADC's by one or more analog input multiplexers. The analog input multiplexers shall be of the solid state differential type and shall employ successive approximation or dual slope integration to digitize the sampled analog signals into a 12 bit binary value; with an accuracy of  $\pm 0.05\%$  of full scale. Input power supply shall be 24 volts DC from the I/O power supply subsystem where power is not supplied by the associated field instrument.
2. Discrete Input: Dry Contact: The input subsystem shall sense the open or closed status of contacts at each scan interval. Sensing power shall be 24 volts DC from the I/O power supply subsystem. Powered input: The input subsystem shall sense the status of 120VAC inputs at each scan interval. Power for inputs is derived from the source system or equipment. Coordinate with Owner and other drawings for the requirements of either dry contact or powered input and provide accordingly.
3. Analog Output: The analog output subsystem shall accept incremental signals from the process controller. A solid state digital to analog converter (DAC) shall be provided for each analog output. The incremental signals from the process controller

- shall increment or decrement the 4-20 MA output signal from each DAC. A 24 volt DC power supply shall be provided for analog outputs from the I/O power supply subsystem. The output of each DAC shall be continuously maintained and shall have a drift rate no greater than 2% in 24 hours. Each DAC shall have a 12 bit resolution and an accuracy of  $\pm 0.05\%$  full scale.
4. Discrete Output: The discrete output subsystem shall be of the solid state type and shall generate maintained or momentary outputs as required to operate interposing relays provided in related circuitry. Diode protection (in addition to surge protection) shall be provided on all discrete outputs. The output contacts shall be rated 24 VDC/120 VAC, 5A SPDT. Match Orange County standard for discrete output (120VAC).
  5. Power Supplies: Input/output (I/O) subsystem power supplies shall be provided for each PLC control panel and shall be sized to power all 2-wire and 4-wire discrete and analog DC circuits under full-load conditions including allowances for specified spares. The incoming power source to the I/O subsystem power supplies shall be 115 VAC from the associated panelboard. Transformation, rectification and smoothing circuitry shall be furnished to provide a regulated 24 volt DC power supply. The DC power supply shall be converted to other DC voltage levels as required. Provide 24VDC power supply with diode protection and alarm (PLC input) in case of power supply failure, if shown on drawings.

## 2.06 ACCESSORIES

- A. General purpose relays in the control panels shall be plug in type with contacts rated 10 amperes at 120 volts AC and LED indicator. The quantity and type of contacts shall be as shown on the Drawings. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals. Relays shall be Potter and Brumfield Type KRP or KUP, Square-D Type K, or equal.
- B. Time delay relays shall be solid state on-delay or off-delay type with contacts rated 10 amperes at 120VAC. Units shall include adjustable dial with graduated scale or digital switch setting covering the time range in each case. Time delay relays shall be Agastat Series 7000, Omron series H3, SSAC type TDM or approved equal.
- C. Additional slave relays shall be installed when the number or type of contacts shown exceed the contact capacity of the specified relays and timers.
- D. All indication lights shall be LED type, round 22 mm (minimum) configuration, heavy duty and corrosion resistant type. Non-LED type indication lights are not acceptable. Switches shall be round 30.5mm configuration, heavy duty and corrosion resistant. Legend plate shall be standard size square style laminate with white field and black markings as shown. LED Indicating lights shall have integral transformer for operation from 120VAC, if necessary. Pushbuttons shall include full guard with flush button and selector switches shall include a black non-illuminated knob on switch, unless otherwise noted. Contact arrangement and configuration shall be as shown. Devices shall be Cutler Hammer Type E-30, General Electric Type CR104, Square D class 9001 type Sk, Allen Bradley Bulletin 800 or equal.

- E. Selector switches shall be of the rotary type with the number of positions as shown on the Drawings. Color, escutcheon engravings, contact configurations and the like shall be as shown. Devices shall be Cutler Hammer Type E-24, General Electric Type CR104, or equal.
- F. Circuit breakers shall be single pole, 120 volt, 15 ampere rating or as required to protect wires and equipment and mounted inside the panels as shown.
- G. Nameplates shall be supplied for identification of all field mounted elements, including flow meters and their transmitters. These nameplates shall identify the instrument, or meter, descriptively, as to function and system. These nameplates shall be fabricated from black-face, white-center, laminated engraving plastic. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, each electronic trip, and the like, mounted inside the control panels. These shall be descriptive, to define the function and system of such element. Adhesives shall be acceptable for attaching nameplates. Painted surfaces must be prepared to allow permanent bonding of adhesives. Nameplates shall be provided for instruments, function titles for each group of instruments and other components mounted on the front of the control panels as shown. These nameplates and/or individual letters shall be fabricated from VI-LAM, Catalog No. 200, manufactured by N/P Company, or equivalent by Formica, or equal. Colors, lettering, style and sizes shall be as shown or as selected by the Engineer.
- H. Solenoid Valves if not otherwise noted shall be globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation. Materials shall be brass globe valved bodies and Buna-N valve seats. The size shall be 1/4-inch normally closed. The coil shall be 115 VAC coil, Nema 4 solenoid enclosure. Manufacturer shall be ASCO; Red Hat, or equal.

## 2.07 SURGE PROTECTIVE DEVICE (SPD) FOR SURGE PROTECTION

- A. General: Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable case, properly grounded. Ground wires for all TVSS shall be connected to a good earth ground and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4X junction box coupled to the enclosure.
- B. Power Supply: Protection of all 120 VAC instrument power supply lines shall be provided. Control panels shall be protected by line noise suppressing isolation transformers and surge. Field instruments shall be protected by SPD. For control panels, the line noise suppressing isolation transformer shall be Eaton Power Shure isolators or approved equal. The suppressor shall be Edco HSP-121, Surge Suppression Incorporated, Current Technology, or Joslyn.

- C. Signals: Protection of analog signal lines originating and terminating not in the same building shall be provided by SPD. For analog signal lines the SPD shall be MTL-SD32X. For field mounted two-wire instruments the SPD shall be encapsulated in stainless steel pipe nipples, and shall be MTL-TP32-N. For field mounted four-wire 120VAC instruments, the SPD shall be in a NEMA 4X polycarbonate enclosure, SD32X (analog) and MA15/D/I/SI for 120VAC.

## 2.08 INSTRUMENTATION AND CONTROL EQUIPMENT SPECIFICATIONS

### A. Oak Meadow HMI Workstation

1. Dell Precision T5610 or current family product comprised of the following configuration. This configuration is to be provided as a minimum:
  - a. Processor type: Quad-Core {Intel Xeon}
  - b. Processor speed: 2.4 Ghz
  - c. Monitor type: Flat Panel, dual configuration
  - d. Monitor size: 24-inch Ultrasharp monitor 1200 x 1600 Resolution
  - e. Memory size {RAM}: 8 GB
  - f. Two 500 GB hard drives or larger with integrated RAID 1 controller
  - g. Single CPU, dual capable
  - h. 16X DVD-RW DL
  - i. 256 MB PCIe Dual Monitor DVI capable video card
  - j. 6 MB Cache
  - k. Two 10/100/1000 Gigabit RJ-4S connectivity Ethernet controller PCIe cards.
  - l. 3 button Intellimouse
  - m. Standard Windows keyboard
  - n. 2 Serial Ports standard
  - o. 2 Parallel Port standard or USB ports
  - p. Sound Card and speakers
  - q. MS Windows 7 Professional Full Service, Service Pack 1, 32-bit capable
  - r. Microsoft Office 2010 Professional 32-bit capable
  - s. GE Proficy iFIX VS.8 with development key license
  - t. Resource DVD or USB contains Diagnostics and Drivers
2. Monitor to be mounted behind plexiglass in front of PLC enclosure door. Keyboard and mouse mounted to front of PLC enclosure in a fold down tray, replace front door in its entirety.

## 2.09 CONTROL STRATEGY SCHEDULES

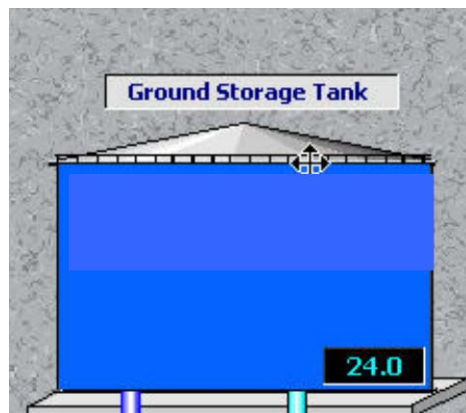
The control strategies are written descriptions of the programming required to implement regulatory and sequential control of the unit processes. Control strategies shall fully reside in the memory of the designated PLC. Coefficients pertaining to control strategies shall be modifiable through the operator interface in the monitoring / control mode. I&C supplier shall obtain the existing PLC programs of the each facility chemical feed pumps control system and mimic the new control system with additional control features stated below.

The I&C supplier shall include an additional 160 hours on-site to fine tune control systems and make minor software modifications in order to resolve any logic discrepancies encountered during start-up, and supply the Owner with a complete functional system. This shall be part of the bid package with no additional cost to the owner.

A. General Logic Description:

1. Auto-Manual Start-Stop scheme for all equipment (pump or valves) shall operate on the following way: Any equipment shall have Auto and Manual mode selectable from the HMI screen. In Auto mode the particular pump or valve shall follow the auto control strategy described above. In Manual mode, operator shall be able to Start, Stop, Open or Close pump/ Valve from the HMI screen. VFD pump or modulating valve shall have in addition the manual set point for speed/ position.
2. The control system shall be designed to allow online calibration and repair of instruments used in the plant control scheme without disruption of the plant process or production rate. This shall be accomplished using operator selectable process hold values in conjunction with operator selectable hold timers and alarms to remind operators to reset the system to active inputs.
3. All alarms that are generated by the PLC and have active role in PLC logic, shall be latched, and shall be resetable from the HMI screens, except the alarms that need to be reset on the field.
4. All alarms that are generated by the PLC and have only monitoring purposes, shall be present only while the conditions that caused the alarm are present, and be automatically reset when the conditions are no longer present.
5. All alarms generated by the PLC shall have selectable value in HMI for alarm set point, and selectable time delay.
6. All flow pacing controls (or pacing controls of any kind) shall include a ratio factor that can be entered from the screens. Also, PLC programmer shall leave the option of adding calculation blocks for all pacing controls as required during the startup.
7. All Set points for PID loops shall be enterable from the screen together with percentage that PLC shall use to calculate stage up and stage down set points. That calculation shall be one scan operation. After that one scan operation initiated by either entering the PID set point or percentage, operator shall be able to overwrite calculated values from the screen

B. Ground Storage Tank (Bent Oaks)



1. While there is no equipment to control on the GST, the level in the tank is used for many other control strategies. The level will be used to determine the status of the fill valves; the HSP use the low-low level signal as an interlock.
2. Since the fill valves automatically open or close based off the GST level reading, if the GST transmitter fails, the fill valve automatically default to AUTO/OFF if they were in the AUTO/AUTO mode. The operator may operate the fill valve by placing them to AUTO/MANUAL mode. The operator will have the option of manually controlling the fill valves.
3. Since the HSP use the level transmitter to derive a low low level lockout, if the GST transmitter fails, the HSP shall automatically default to AUTO/OFF mode. The operator may run the pumps by placing them to AUTO/MANUAL mode. HSPs shall not shut down.
4. Alarm level set points will be in feet and will be adjustable through the Eastern and Western Regional HMI as well as the local MMI.
5. Alarms
  - a. High high level.
  - b. High level.
  - c. Low level.
  - d. Low low level (Float) (HSP Lockout).
6. Tank Level Control (Fill Valves #1)
  - a. AUTO MODE
    - 1) When selecting “AUTO MODE” the operator is provided with a drop-down setpoint which allows the entry of a number to determine the percent open. Once this setpoint number is entered the valve will open to within 2% of this value (via the feedback from the position transmitter). To achieve this opening mode the Open Solenoid Valve will pulse on for two seconds (operator adjustable), off for five seconds (operator adjustable), on for two seconds, off for five seconds, etc. until the setpoint (plus or minus two percent) is reached. Once the setpoint is reached the Open Solenoid Valve will cease to pulse. While in Auto changing the setpoint to any number outside the 2% dead band will prompt the correct response (opening or closing) to achieve the new setpoint.
    - 2) If in Auto and at the desired setpoint position the Close Solenoid Valve will energize (while the mode stays in AUTO) based on the following criteria:
      - (a) If any HSP is running or if the line pressure goes low (40 psig or less) for 10 or more seconds the CLOSE solenoid valve will energize. If the pressure goes high (50 psig or more) for 10 or more seconds the CLOSE solenoid valve will de-energize or if there is a power loss to the plant.



- 3) If in Auto and at the desired setpoint position the mode will change from AUTO to CLOSE based on the following criteria:
    - (a) If the level in the selected GST goes high (20 ft. or more; 22.5 ft. = 100%) for 3 or more seconds or the watchdog timer (which tracks communication from SCADA to the local PLC) times out.
  - 4) To get back to AUTO the operator has to make the selection.
- b. CLOSE MODE
- 1) When the “CLOSE MODE” is selected the Close Solenoid Valve will pulse on for two seconds, off for five seconds, on for two seconds, off for five seconds, etc. until the position transmitter decreases to 2% or less. Once this value of 2% is reached the Close Solenoid Valve will remain energized for 30 seconds. While in the “CLOSE MODE” to prevent leaking past the Fill Valve the Close Solenoid Valve will be pulsed on for 30 seconds (operator adjustable) of every 600 seconds (i.e., 30 seconds on, 570 seconds, off, continuously).
- c. INTERLOCKS
- 1) In event of Position Transmitter failure (4-20 ma loop is faulty) the following rules apply:
    - (a) In the “CLOSE MODE” the Close Solenoid Valve will energize for 120 consecutive seconds. As noted above the valve will continue to close for 30 seconds of every 600 seconds.
    - (b) When the “OPEN MODE” is selected the Open Solenoid Valve will energize for 8 consecutive seconds. Based on the 5% opening per 2 seconds this will provide an opening of around 20%.

## 2.10 INSTRUMENT LIST

TAG NO.	COMPONENT CODE	COMPONENT TITLE	COMPONENT OPTIONS	REMARKS
PE/PIT-001	PE/PIT-001	Pressure Transmitter		

A. This specification covers the following services:

1. Gauge Pressure

B. Meet the following unless otherwise noted on the instrument schedule:

- |                        |   |
|------------------------|---|
| 1. Mounting:           | Provide corrosive resistant hardware required for mounting the instrument.      |
| 2. Enclosure:          | Unless otherwise shown on the instrument schedule, provide NEMA 4X pipe mounted |
| 3. Power Supply:       | 12-48 Vdc (signal loop powered).  |
| 4. Output:             | 4-20 mA <sub>dc</sub> , direct acting into 600 ohms minimum.                    |
| 5. Zero Suppression or | 150 percent of calibrated span.   |

Range Elevation:	
6. Range:	0 to 150 psig.
7. Certifications:	NSF
8. Humidity:	10 to 100 percent non-condensing.
9. Sensing Element:	Diaphragm type.
10. Vent/Drain Valve:	One each sensing cavity.
11. Material:	Sensing element components to be 316L stainless steel, or as shown on the instrument schedule.
12. Process Connection:	0.5 inch-14 NPT unless noted otherwise in the instrument schedule.
13. Electrical:	0.5 inch rigid conduit with screw terminals. Provide electrical protection against lightning.
14. Freeze Protection:	If the transmitter and process piping are located outdoors, provide freezing protection for both.
15. Design:	Provide microprocessor-based electronic design with digital communication capability and industry standard protocol.
16. Hardware:	All 316 stainless steel.

C. Provide local output indicators. Meet the following requirements:

1. Mounting: Integrally mounted on the pressure transmitter enclosure or on an enclosure near to the transmitter.
2. Enclosure: Aluminum.
3. Accuracy: +/-2.0 percent of span.
4. Scale: linear with process variable except differential pressure flow that shall be linearly proportional to flow. All scales shall be provided to read in engineering units to match process.
5. Manufacturer: Same as transmitter.

D. Provide block and shutoff valves. Meet the following requirements:

1. Size: 0.5 inch (1.0 inch for diaphragm seal installations).
2. Type: Ball.
3. Pressure: Up to 100 psi.
4. Body: Brass or bronze, for non-corrosive atmosphere, PVC or epoxy coated for corrosive atmosphere.
5. Seats and Seals: Teflon.
6. Ball and Stem: Same material as sensing element.
7. Provide: Gemini valve series 76, Apollo model 70-103, or equal.
8. Valves: 316 stainless steel
9. Hardware: 316 stainless steel

E. Manufacturer: Rosemount 3051TG

## 2.11 PROGRAMMING SOFTWARE

- A. The Contractor is responsible for using the PLC programming software (ProWORKX NxT) with the same version that the County is currently using for the PLC type specified under specification 13300. No PLC software license is required for this project for the Owner.
- B. Replace existing CPUs with #140CPU43412A. Typical three (3) places.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION, CALIBRATION, TESTING, START-UP AND INSTRUCTION**

- A. General: Under the supervision of the Single I&C supplier, all systems specified in this Section shall be installed, connected, calibrated and tested, and in coordination with the Engineer and the Owner, shall be started to place the processes in operation. This shall include final calibration in concert with equipment specified elsewhere in these Specifications, including pumps, valves, as well as certain existing equipment.
- B. Testing: All control systems both new and existing shall be exercised through operational tests in the presence of the Engineer in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Specifications. The scheduling of tests shall be coordinated by the Contractor among all parties involved so that the tests may proceed without delays or disruption by incomplete work.
  - 1. Un-witnessed Factory Test (UFT): An un-witnessed factory test shall be conducted to prepare the I&C Supplier to demonstrate compliance with this specification during the Factory Acceptance Test (FAT). The I&C Supplier shall prepare a written procedure detailing every aspect of the UFT. This procedure must be submitted to the ENGINEER for approval prior to the commencement of the UFT. This procedure along with any forms generated during the UFT shall comprise the basis of the FAT. The I&C Supplier shall inspect and test the Integrated Control System (ICS) to ensure it is ready for the FAT. This test shall take place at the I&C Supplier's factory. It shall consist of interconnecting computers, PLC control panels, communications links, and other new Control Panels (unless specifically excluded below). All primary element inputs shall be simulated (inputs shall be adjustable by switch, if discrete; by potentiometer or similar device, if analog). Primary outputs shall be monitored via output devices (LED indication lights, for discrete; a meter, digital display (12-bit min. resolution) or other such analog device, if analog output).

During the UFT, the Contractor shall test the communications links and demonstrate error-free communications to and from each node on the fiber optic network. Verify that each I/O point is consistently mapped at the computer node, at the PLC I/O card, in the PLC memory, and at the I/O simulated device according to the database provided by the software engineer. Verify the proper operation of each of the pilot devices on each of the control panels, if any.
  - 2. Excluded New Panels: None
  - 3. Factory Acceptance Test (FAT): The I&C Supplier shall test the entire control system. The test shall take place at the I&C Supplier's factory. The I&C Supplier

shall simulate all inputs and outputs as performed in the UFT. The software engineer shall load application programs into each PLC. The software engineer shall load the HMI application into the computer. Owner and Owner's Consultant will participate and witness in FAT. Provide a minimum of 2 weeks' notice to the Owner/Engineer before conducting testing. I&C Supplier shall provide all expenses for Owner and Engineer at the FAT. Prior to commencement of the FAT, the I&C Supplier shall furnish the following documentation to the Engineer:

- a. All Drawings, Specifications, Addenda, and Change Orders
- b. Master copy of the written FAT procedures
- c. List of equipment to be tested
- d. Shop drawings of equipment to be tested
- e. Preliminary Software documentation submittal

Daily Schedule for FAT:

- a. Begin each day with a meeting to review the day's test schedule
- b. End each day with a meeting to review the day's test results and to review and to revise the next day's test schedule, if required.

The I&C Supplier shall repeat the I/O point mapping consistency check as before, with the addition of verification of mapping on HMI screens. Those variables, which are not I/O but are variables which exist in the PLC and HMI software only (see preliminary software documentation), shall all be checked. Check the function of each loop, including set points, alarms, displays, and operator interface. Check all loops. Check data logging, alarm logging, and event logging. Test all non-loop-specific functions including, but not limited to the following:

- a. Demonstrate capacity of system for expansion. Include tests for both storage capacity and processing capacity.
- b. Include tests for timing requirements.
- c. Demonstrate online and offline diagnostic tests, procedures and displays.
- d. Demonstrate Failure Mode and Backup Procedures: Power failure, auto restart, disk backup and reload, retentive outputs.

Correct deficiencies found and complete correction of deficiencies prior to shipment to site. Failed Tests shall be repeated and witnessed by the Owner and Engineer. With approval of the Engineer or Owner certain tests may be conducted by the I&C Supplier and Witnessed by the Engineer and Engineer during START-UP. I&C supplier shall include in his or her bid allowance for travel expenses for 3 persons (2 from Owner, and 1 Engineer) for entire system FAT – duration maximum 5 days. Travel expenses shall include car rental, accommodation and food for each person during FAT period. See section 3.02 supplements for sample "Loop Status Report" and "Functional Acceptance Test Sheet".

#### C. Installation And Connection:

1. The Contractor shall install and connect all field-mounted components and assemblies under the criteria imposed in Part 1, 1.03, herein. The installation personnel shall be provided with a final reviewed copy of the Shop Drawings and data.
2. The instrument process sensing lines and air signal tubing shall, in general, be installed in a similar manner to the installation of conduit specified under Section

16100. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 feet of rigid tubing.

3. Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels.
4. The Contractor shall have a technical field representative of the I&C supplier to instruct these installation personnel on any and all installation requirements; thereafter, the technical field representative shall be readily available by telephone to answer questions and supply clarification when needed by the installation personnel.
5. Where primary elements (supplied by I&C supplier) shall be part of a mechanical system, the I&C supplier shall coordinate the installation of the primary elements with the mechanical system manufacturer.
6. Finally, after all installation and connection work has been completed, the technical field representative shall check it all for correctness, verifying polarity of electric power and signal connections, making sure all process connections are free of leaks, and all such similar details. If the initial inspection finds no deficiencies, the technical field representative shall proceed to the certification to the Contractor. Any completed work that is found to have deficiencies shall have those deficiencies corrected by installation personnel at no additional cost to the Owner. The technical field representative shall then recheck the work after the identified deficiencies are corrected. If the technical field representative finds deficiencies in the follow-up inspection, then remedial action shall be taken by the Contractor at no cost to the Owner. This pattern shall be repeated until the installation is free from defect. The technical field representative shall then certify in writing to the Contractor that for each loop or system that he has inspected is complete and without discrepancies.
7. The field representative of the Single I&C supplier shall coordinate all work required to interface the new equipment and control devices with the existing equipment, including all required modifications to existing equipment and related devices.

D. Calibration:

1. All instruments and systems shall be calibrated after installation, in conformance with the component manufacturer's written instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation, and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. This calibration work shall be accomplished by the technical field representatives of the I&C system supplier who shall certify in writing to the Contractor that for each loop or system all calibrations have been made and that all instruments are ready to operate. See section 3.02 supplements for sample "Instrumentation Calibration Sheet".
2. Proof of Conformance -The burden of proof of conformance to specified accuracy and performance is on the Contractor using its designated Single I&C supplier. The Contractor's designer shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to

the Owner, wherever reasonable doubt or evidence of malfunction or poor performance may appear within the guarantee period.

- E. Pre-Commissioning: The I&C Supplier shall test each loop (discrete and analog) to determine if it is functioning correctly. The I&C Supplier shall furnish a loop sheet for each loop to be tested. The loop sheet shall represent the actual "as-built" condition of the loop. The I&C Supplier shall perform a field functional loop test which shall be witnessed by the Engineer and Owner. If the loop fails the functional test, the I&C Supplier shall coordinate repairs for the Contractor to correct whatever is wrong with the loop. The I&C Supplier shall retest the loop until it is approved. Each loop shall be tested and approved by Engineer and Owner until all loops have been approved.
- F. Start-Up And Instruction: When all systems are assessed by the Contractor to have been successfully carried through complete operational tests with a minimum of simulation, and the Engineer concurs in this assessment, plant start-up by the Owner's operating personnel can follow. For a minimum of three times for (4) hours prior to start-up, operating and maintenance personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting or checking, re-calibration or maintenance by them from time to time. This instruction shall be scheduled at a time arranged with the Owner at least two (2) weeks in advance. Instruction shall be given by qualified persons who have been made familiar in advance with the systems. All equipment shall be checked during the first year of operation at intervals of three months for a period of not less than one day or as may be required to correct any defects to the satisfaction of the Owner.
- G. Modifications To Existing Facilities: The Contractor shall make all modifications to existing equipment and control devices which are required to successfully install and integrate all new instrumentation equipment. All costs for any required modification and rehabilitation effort shall be included in the Contractor's original bid amount and no additional payment shall be allowed.
- H. Plant Shutdowns: The Single I&C supplier shall carefully examine all work to be performed relative to existing I&C equipment and the installation of new equipment and control devices. Work shall be scheduled to minimize required plant shutdown times.
- I. Coordination With Other Concurrent Projects: The single I&C supplier shall coordinate extensively with other I&C suppliers of concurrent projects. Some of the equipment shown in this contract as existing might be installed while this contract is underway.

### 3.02 TRAINING

- A. General:
  - 1. Provide an integrated training program to meet specific needs of Owner's personnel.
  - 2. Provide instruction on one working shift as needed to accommodate the Owner's personnel schedule.
  - 3. Owner reserves the right to make and reuse video tapes of training sessions if applicable.

- B. Operations and Maintenance Training:
  - 1. Include a review of O&M manuals, expendables, and test equipment.
  - 2. Training session duration shall be minimum 4 hours. Provide training schedule with outlines at least one week before the training to the Owner.
  - 3. Training shall include a minimum understanding of loop functions, loop operation, component calibration, adjustments such as controller tuning, switch trip point, etc., and periodic maintenance.

### 3.03 SUPPLEMENTS

- A. Supplements listed below shall be provided by the Integrator.
  - 1. Instrumentation Calibration Sheet
  - 2. Loop Status Report
  - 3. Functional Acceptance Test Sheet

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

**PART 1 – GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. All equipment furnished and installed under this contract shall conform to the general stipulations set forth in this Section except as otherwise specified in other sections.
2. Contractor shall coordinate all details of equipment with other related parts of the Work, including verification that all structures, slabs, supports, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alternations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

B. General Design:

1. Contract Drawings and Specifications: The Contract Drawings and Specifications shall be considered as complementary 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 Contract Drawings are to be considered diagrammatic, not necessarily showing in detail or to scale all of the equipment or minor items. In the event of discrepancies between the Contract Drawings and Specifications, or between either of these and any regulations or ordinances governing work of these Specifications, the bidder shall notify the Engineer in ample time to permit revisions.

1.02 QUALITY ASSURANCE

A. Materials and Equipment: Unless otherwise specified, all materials and equipment furnished for permanent installation in the work shall conform to applicable standards and specifications and shall be new, unused, and undamaged when installed or otherwise incorporated in the work. No such material or equipment shall be used by the Contractor for any purpose other than that intended or specified, unless such use is specifically authorized in writing by the Owner. No material shall be delivered to the work site without prior acceptance of drawings and data by the Engineer.

B. Where applicable, manufacturers shall be selected from the Orange County Utilities "List of Materials and Approved Manufacturers" (see Appendix).

C. Equivalent Materials and Equipment:

1. When a material or article is specified or described by name of a proprietary product or of a particular manufacturer or vendor, the mentioned item shall be understood as establishing the type, function, and quality desired. Other manufacturers' products

- may be accepted provided sufficient information is submitted to allow the Engineer to determine that the products proposed are equivalent to those named. Such items shall be submitted for review in accordance with Section 01300: Submittals.
2. Requests for review of equivalency will not be accepted only from the Contractor and such requests will not be considered until after the contract has been awarded.
- D. Governing Standards: Equipment and appurtenances shall be designed in conformity with ANSI, ASME, ASTM, IEEE, NEMA, OSHA, AGMA, and other generally accepted applicable standards. They shall be of rugged construction and of sufficient strength to withstand all stresses that 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 acceptable means. Provisions shall be made for adequate lubrication with readily accessible means.
- E. Tolerances: Machinery parts shall conform to the dimensions indicated on the Drawings within allowable tolerances. 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.
- F. Clearances: Ample clearances 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 or her expense.
- G. Testing:
1. When the equipment is specified 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.
  2. 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 Contractor. All testing shall be done in the presence of the Contractor. "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 and painted.
- H. Pressure Test:
1. After installation, all piping shall be pressure tested. Piping shall be tested in accordance with Section 15044.
  2. All tests shall be made in the presence of and to the satisfaction of the Construction Manager and also to the satisfaction of any local or state inspector having jurisdiction.
    - a. Provide not less than three days notice to the Construction Manager and the authority having jurisdiction when it is proposed to make the tests.
    - b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Construction Manager shall be retested in part or in whole as directed by the Construction Manager.

- c. The piping systems may be tested in sections as the work progresses by no joint or portion of the system shall be left untested.
  3. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
  4. 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.
  5. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.
  6. Provide test pumps, gauges, or other instruments and equipment required for the performance of all tests. Provide all temporary bracing, test plugs, additional restraint, and thrust blocking which may be required for test pressures above normal working pressures.
  7. 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.
- I. Failure of Test:
  1. Defects: 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 or her having made partial payment for work and materials which have entered into the manufacturer for such equipment, may reject that equipment and order the Contractor to remove it from the premises at the Contractor's expense.
  2. Rejection of Equipment: In case the Owner rejects a particular item of equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him to deliver to the Contractor a bill of sale of all his or her 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 or her without rental or other charge until the other equipment is obtained.
- J. Responsibility during Tests: 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.
- K. Acceptance of Materials:
  1. Only new materials and equipment shall be incorporated in the work. All materials and equipment furnished by the Contractor shall be subject to the inspection and

acceptance of the Owner. No material shall be delivered to the work without prior submittal approval of the Engineer.

2. The Contractor shall submit to the Engineer data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the specifications.
3. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the Contractor. If the Engineer requires, either prior to beginning or during the progress of the work, the Contractor shall submit samples of materials for such special test as may be necessary to demonstrate that they conform to the specification. Such sample shall be furnished, stored, packed, and shipped as directed at the Contractor's expense. Except as otherwise noted, the Owner will make arrangements for and pay for tests.
4. The Contractor shall submit data and samples sufficiently early to permit consideration and acceptance before materials are necessary for incorporation in the work.

L. Safety Requirements:

1. In addition to the components shown and specified, all machinery and equipment shall be safeguarded in accordance with the safety features required by the current codes and regulations of 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 double inlet 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 SUBMITTALS (SEE SECTION 01300: SUBMITTALS)

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Packaging: All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.
- B. Protection: 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. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage as specified in Sections 09900 and 09905. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.
- C. Lubrication: Grease and lubricating oil shall be applied to all bearings and similar items as necessary to prevent damage during shipment and storage.

- D. Marking: Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.
- E. Fabricated subassemblies, if any, shall be shipped in convenient sections as permitted by carrier regulations and shall be properly match-marked for ease of field erection.
- F. Responsibility:
1. The Contractor shall be responsible for all material, equipment, and supplies sold and delivered to the site under this Contract until final inspection of the work and acceptance thereof by the Owner. In the event any such material, equipment, and supplies are lost, stolen, damaged, or destroyed prior to final inspection and acceptance, the Contractor shall replace same without additional cost to the Owner.
  2. Should the 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, the Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the 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.
- G. Delivery: Contractor shall arrange deliveries of products in accordance with construction schedules and coordinate to avoid conflict with work and condition at the site.
1. Contractor shall deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
  2. Immediately on delivery, Contractor shall inspect shipments to assure compliance with requirements of Contract Documents and accepted submittals, and that products are properly protected and undamaged.
  3. Under no circumstances shall Contractor deliver equipment to the site more than one month prior to installation without written authorization from the Construction Manager. Operation and maintenance data shall be submitted to the Engineer for review prior to shipment of equipment as described in Section 01730: Operating and Maintenance Data.
- H. Storage and Protection of Products:
1. The Contractor shall furnish a covered, weather-protected storage structure providing a clean, dry, noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into this project. Equipment storage shall be in strict accordance with the "Instructions for Storage" of each equipment supplier and manufacturer including connection of space heaters and placing of storage lubricants in equipment. Corroded, damaged, or deteriorated equipment and parts shall be replaced before acceptance of the project. Equipment and materials not properly stored will not be included in a payment estimate.
    - a. Contractor shall store products subject to damage by the elements in weather-tight enclosures.

- b. Contractor shall maintain temperature and humidity within the ranges required by manufacturer's instructions.
  - c. Contractor shall store fabricated products aboveground, on blocking or skids, to prevent soiling or staining. Contractor shall cover products that are subject to deterioration with impervious sheet coverings and provide adequate ventilation to avoid condensation.
  - d. Contractor shall store loose granular materials in a well drained area on solid surfaces to prevent mixing with foreign matter.
2. All materials and equipment to be incorporated in the work shall be handled and stored by the 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.
  3. 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, staining, chipping, or cracking. Brick, block, and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking and peeling to a minimum.
  4. All materials that, in the Construction Manager's opinion, have become damaged and are unfit for the intended or specified use shall be promptly removed from the site and Contractor shall receive no compensation for the damaged material or its removal.
  5. Contractor shall arrange storage in a manner to provide easy access for inspection. Contractor shall make periodic inspections of stored products to assure products are maintained under specified conditions and free from damage or deterioration.
  6. Protection after Installation: Contractor shall provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Contractor shall remove covering when no longer needed.
- I. Extended Storage Requirements for Equipment: Because of the long period allowed for construction, special attention shall be given to extended storage and handling of equipment onsite. As a minimum, the procedure specified herein shall be followed:
1. If equipment will be stored onsite for more than one month prior to incorporation into the Work, the Contractor shall submit a written request to the Construction Manager outlining any special provision to be made to protect and maintain the equipment while it is being stored. All such provisions shall be acceptable to the Construction Manager. No equipment shall be stored onsite for more than one month without prior written authorization from the Construction Manager.
  2. All equipment having moving parts, including gears, electric motors, and/or instruments, shall be stored in a temperature- and humidity-controlled building accepted by the Construction Manager until such time as the equipment installation.
  3. All equipment shall be stored fully lubricated with oil and grease unless otherwise instructed by the manufacturer.
  4. Manufacturer's storage instructions shall be carefully studied by Contractor and reviewed by Contractor with the Construction Manager. These instructions shall be carefully followed and a written record of this review kept by the Contractor.

5. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon equipment installation, the Contractor shall start the equipment, and operate loaded when possible, weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
6. Lubricants shall be changed upon installation completion and as often as required thereafter during the period between installation and acceptance. If stored for longer than ninety days, mechanical equipment to be used in the work shall have the bearings cleaned, flushed, and lubricated prior to testing and startup, at no extra cost to the Owner.
7. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective, and it shall be removed and replaced at Contractor's expense.
8. A maintenance log shall be maintained by the Contractor outlining the schedule of maintenance required for each piece of equipment, the date on which the maintenance was actually performed, and the initials of the individual performing the work. Submit a copy of the maintenance log monthly with the progress pay application.
9. All motors for storage shall have motor space heater active and wired from nearest power source to prevent moisture entering the motor.

#### 1.05 WARRANTY AND GUARANTEES

- A. The manufacturer's written warranty shall be submitted for all major pieces of equipment, as specified in Section 01740: Warranties and Bonds. The manufacturer's warranty period shall be concurrent with the Contractor's correction period for one year after the time of completion and acceptance.

### **PART 2 – PRODUCTS**

#### 2.01 GENERAL

- A. All materials that come into contact with the water being treated or the finished water shall be on either the EPA or NSF lists of products 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 62555.320(3) Florida Administrative Code.

#### 2.02 MATERIALS AND EQUIPMENT

- A. Fabrication and Manufacture:
  1. Workmanship and Materials:

- a. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.
  - b. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.
  - c. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least ¼-inch thick.
2. Lubrication:
- a. Equipment shall be adequately lubricated by systems that require attention no more than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.
  - b. Lubricants of the type recommended by the equipment manufacturer shall be furnished by the Contractor in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.
  - c. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.
3. Safety Guards: All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage or heavier galvanized or aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard and shall be galvanized, including bolts. All outdoor safety guards shall be designed to prevent the entrance of rain and dripping water.
4. Equipment Foundation Supports:
- a. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by Contractor.
  - b. Unless otherwise indicated or specified, all equipment shall be installed on reinforced concrete bases at least 6 inches high and shall conform to Section 03300. Cast-iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in Section 03600: Grout. All open



- equipment bases shall be filled with non-shrinking grout sloped to drain to the perimeter of the base.
- 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. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall comply with Section 05500: Miscellaneous Metals and, unless otherwise specified, shall have a minimum diameter of 3/4-inch. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1½ inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.
  - 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, thrust blocks, inertia blocks and structural steel supports shall be built to template and reinforced as required for loads imposed on them.
  - g. Contractor shall assume all responsibility for sizes, locations, and design of all foundations, anchor pads, pier, thrust blocks, inertia blocks, curbs and structural steel supports.
5. Shop Painting:
- a. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with high-grade, oil-resistant enamel suitable for coating in the field with an alkyd enamel. Coatings shall be suitable for the environment where the equipment is installed.
  - b. Surfaces to be painted after installation shall be prepared as recommended by the paint manufacturer for the intended service and then shop painted with one or more coats of the specified primer. Unless otherwise specified, the shop primer for steel and iron surfaces shall be Cook "391-N-167 Barrier Coat", Koppers "No. 10 Inhibitive Primer", or equal.
  - c. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound, Houghton "Rust Veto 344", Rust-Oleum "R-9", or equal.
6. Nameplates: Contractor shall provide equipment identification nameplates for each item of equipment. Nameplates shall be 1/8-inch Type 304 stainless steel and shall be permanently fastened using round head metallic drive screws, or, where metallic drive screws are impractical, with stainless steel pop rivets. Metallic drive screws shall be brass or stainless steel, Type V and No. 8 by 3/8-inch long. Names and/or equipment designations shall be engraved on the plates and the engraving painted with a primer and black paint system compatible with stainless steel. Contractor shall

- submit a list of proposed names and designations for review prior to fabrication of nameplates. At a minimum, each nameplate shall include equipment manufacturer's name, year of manufacture, serial number, and principal rating data.
7. Pipe Identification:
    - a. All pipe (except underground) shall have code letters and flow arrows painted as per specification Section 09905. The contractor shall ensure that the pipes are properly marked.
    - b. Underground pipe and tube: Pipe and tube shall be located by laying 2-inch wide plastic tape continuously along the run of pipe or tube. Where possible, color of tape shall be consistent with the color of bands on interior pipe and as approved by the Engineer, or shall bear an imprinted identification of the line.
      - 1) Location: Tape shall be laid approximately 12 inches below ground surface and directly over pipe location.
      - 2) Manufacturer: Tape shall be as specified in Section 09905.
  8. Valve Identification: On all valves except shut-off valves located at a fixture or piece of equipment, the Contractor shall provide a coded and numbered tag attached with brass chain and/or brass "S" hooks.
    - a. Tag Types:
      - 1) Tags for valves on pipe and tube lines conducting hot medium (steam, condensate, hot water, etc.) shall be brass or anodized aluminum.
      - 2) Tags for all other valves shall be Type 304 stainless steel.
      - 3) Square tags shall be used to indicate normally closed valves and round tags shall indicate normally open valves.
    - b. Coding: In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the line service. All color and letter coding shall be approved by the Engineer.
    - c. Valve Schedule: The Contractor shall provide a typewritten list of all tagged valves giving tag shape, letter code and number, the valve size, type, use, and general location within building.
  9. 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. Flame-proofing treatments will not be acceptable.
  10. Heating, Ventilation, and Domestic Plumbing Equipment:
    - a. Interchangeability: In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays, and other items is essential. All similar items shall be of the same manufacturer, type, model, and dimensions.

## 2.03 ACCESSORIES

- A. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

## 2.04 SPARE PARTS

- A. Spare parts for certain equipment provided under Divisions 11, 13, 14, 15, and 16 have been specified in the pertinent sections of the specifications. The Contractor shall collect and store all spare parts in an area to be designated by the Engineer. In addition, the Contractor shall furnish to the Engineer an inventory listing of all spare part, the equipment with which they are associated, and the name and address of the supplier.
- B. Maintenance Materials:
  - 1. All grease, oil, and fuel required for testing of equipment shall be furnished with the respective equipment. The Owner shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied.
  - 2. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment after initial break-in of the equipment, which in no event shall be any longer than three weeks of operation.

## 2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for project.

## **PART 3 – EXECUTION**

### 3.01 PREPARATION (NOT APPLICABLE)

### 3.02 INSTALLATION

- A. Installation: Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary for proper results. When so specified, or when employees of Contractor or Contractor's subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.
  - 1. The Contractor shall have sufficient proper construction equipment and machinery of ample capacity onsite 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.
  - 2. Equipment shall be erected in a neat and skilled manner on the foundations and supports at the locations and elevations shown on the Drawings, unless otherwise directed by the Engineer during installation.

3. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.
  4. 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.
  5. Equipment of a portable nature that require no installation shall be delivered to a location designated by the Owner.
- B. Tolerances: 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 ½-inch to 30-foot horizontal and vertically. All valves and operators shall be installed in the position shown on the Contract Drawings or as directed by the Engineer, if not shown.
- C. Alignment and Level: The equipment shall be brought to proper level by shims (¼-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. Grouting shall be as specified in Section 03600: Grout.
- D. Grouting: 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.
- E. Contact of Dissimilar Metals: Where the contact of dissimilar metal may cause electrolysis and where aluminum will contact concrete, mortar, or plaster, the contact surface of the metals shall be separated using not less than one coat of zinc chromate primer and one heavy coat of aluminum pigmented asphalt paint on each surface.
- F. Cutting and Patching: All cutting and patching necessary for the work shall be performed by the Contractor.
- G. Operation: All equipment installed under this Contract, including that furnished by Owner or others under separate contract, shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.

### 3.03 INSPECTION AND TESTING

- A. Where the specifications require observation of performance tests by the Construction Manager, such tests shall comply with the quality assurance paragraph in this section.

### 3.04 START-UP AND INSTRUCTION

- A. Services Furnished Under This Contract:
1. An experienced, competent, and authorized representative of the manufacturer of each item of equipment shall visit the site of the Work and inspect, check, adjust if

- necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Construction Manager.
2. Owner and Construction Manager shall be furnished a letter of certification by each manufacturer's representative that states the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated under full load conditions and that it operated satisfactorily.
  3. All costs for field services shall be included in the contract amount.

END OF SECTION

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

**PART 1 – GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies the leakage testing requirements for plant piping.
- B. Related Work Described Elsewhere:
  - 1. Section 11241: Chemical Feed System.
  - 2. Section 15070: Schedule 80 Polyvinyl Chloride (PVC) Pipe, Fittings and Valves.
  - 3. Section 15100: Ancillary Equipment.
- C. General Design (not applicable)

1.02 QUALITY ASSURANCE

- A. Test Pressures: Test pressures for the various services and types of piping shall be as shown in Table 15044-A, and, at a minimum, shall be 1.5 times the working pressure.

1.03 SUBMITTALS

- A. Materials and Shop Drawings (Not Applicable)
- B. Additional Information:
  - 1. Testing Plan: Submit prior to testing and include at least the information that follows:
    - a. Testing dates.
    - b. Piping systems and section(s) to be tested.
    - c. Test type.
    - d. Method of isolation.
    - e. Calculation of maximum allowable leakage for piping section(s) to be tested.
  - 2. Certifications of Calibration: Testing equipment.
  - 3. Certified Test Report.
  - 4. Testing Records:
    - a. Provide a record of each piping installation during the testing. These records shall include:
      - 1) Date of test.
      - 2) Identification of pipeline tested or retested.
      - 3) Identification of pipeline material.
      - 4) Identification of pipe specification.
      - 5) Test fluid.
      - 6) Test pressure.
      - 7) Remarks: Leaks identified (type and location), types of repairs, or corrections made.

- 8) Certification by Contractor that the leakage rate measured conformed to the specifications.
  - 9) Signature of Owner's representative witnessing pipe test.
- b. Submit five (5) copies of the test records to the Engineer's representative upon completion of the testing.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. Testing fluid shall be clean water for all piping except air service and shall be of such quality to prevent corrosion of materials in piping system for all hydrostatic tests. Air piping shall be tested using compressed air.

### **2.02 MATERIALS AND EQUIPMENT**

- A. Provide pressure gauges, necessary bracing and restraint, test plugs, pipes, bulkheads, pumps, and meters to perform the hydrostatic and pneumatic testing.

## **PART 3 – EXECUTION**

### **3.01 PREPARATION**

- A. Pipes shall be in place and anchored before commencing pressure testing.
- B. Conduct hydrostatic and pneumatic tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
- C. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes.
- D. 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.
- E. 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.
- F. Chlorine Piping: Test, dry, and clean in accordance with requirements of Chlorine Institute Pamphlet 6.
- G. New Piping Connected to Existing Piping: Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.



- H. Items that do not require testing include: Piping between wet wells and wet well isolation valves, equipment seal drains, tank overflows to atmospheric vented drains, and tank atmospheric vents.
- I. Gravity Piping:
  - 1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.
  - 2. Determine groundwater level at time of testing by exploratory holes or other method acceptable to Engineer.
- J. Pressure Test:
  - 1. All tests shall be made in the presence of and to the satisfaction of the Owner or Engineer and also to the satisfaction of any local or state inspector having jurisdiction.
    - a. Provide not less than three (3) days notice to the Owner, Engineer, and the authority having jurisdiction when it is proposed to make the tests.
    - b. 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.
    - c. The piping systems may be tested in sections as the work progresses, but no joint or portion of the system shall be left untested.
  - 2. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
  - 3. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.

### 3.02 INSTALLATION (NOT APPLICABLE)

### 3.03 INSPECTION AND TESTING

- A. Hydrostatic Testing of Aboveground or Exposed Piping: The maximum filling velocity shall be 0.25 feet per second, applied over full area of pipe. Open vents at high points of the piping system to purge air while the pipe is being filled. Subject the piping system to the test pressure indicated. Maintain the test pressure for a minimum of four (4) hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show no leakage or weeping. Correct leaks and retest until no leakage is obtained.
- B. Hydrostatic Testing of Buried Piping:
  - 1. Test after backfilling has been completed. Expel air from piping system during filling.
  - 2. 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 soak for at least 48 hours to absorb water before conducting the pressure test.
  - 3. Apply and maintain the test pressure by means of a hydraulic force pump. Maintain the test pressure for a minimum duration of four (4) hours. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure

during the four hours. This amount of water is the loss due to leakage in the piping system. The allowable leakage rate is defined by the formula:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

in which:

L = allowable leakage (gallons/hour) during the test period.

S = length of pipe, in feet

D = nominal diameter of the pipe (inches)

P = average test pressure during leakage test (psig)

4. Repair and retest any pipes showing leakage rates greater than that allowed.

#### C. Pneumatic Test For Pressure Piping:

1. Do not perform on PVC or CPVC pipe.
2. Fluid: Oil-free, dry air.
3. Procedure:
  - a. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections, examine for leakage.
  - b. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
  - c. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
  - d. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
  - e. Correct visible leakage and retest as specified.
4. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.
5. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

#### D. Hydrostatic Test For Gravity Piping:

1. Testing Equipment Accuracy: Plus or minus ½-gallon of water leakage under specified conditions.
2. Maximum Allowable Leakage: 0.16 gallon per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.
3. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.
4. Exfiltration Test:
  - a. Hydrostatic Head:
    - 1) At least 6 feet above maximum estimated groundwater level in section being tested.

- 2) No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
  - 5. Infiltration Test:
    - a. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.
  - 6. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.
  - 7. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.
- E. Test Pressure:
- 1. All pipe shall be tested at pressures shown in Table 15044-A and at a minimum shall be 1.5 times the normal working pressure of the pipe.

3.04 START-UP AND INSTRUCTION (NOT APPLICABLE)

**TABLE 15044-A**

<b>Service</b>	<b>Legend</b>	<b>Maximum Operation Pressure (psig)</b>	<b>Test Pressure (psig)</b>
Drain	DR	Gravity	15 ft. WCH
Hydrofluorosilicic Acid	F	50	100
Sample Line	SA	70	150
Sodium Hypochlorite	C	50	100
Water Main	WM	70	150

Legend: WCH = Water Column Height

END OF SECTION

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**SECTION 15100**  
**ANCILLARY EQUIPMENT**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Provide all valves and appurtenances, ready for operation, as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

- A. All valves, appurtenances, and ancillary equipment shall be products of well-established reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment 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.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All valves, appurtenances, and ancillary equipment shall be of the sizes shown on the Drawings and specified herein.
- B. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
- C. All valves, appurtenances, and ancillary equipment shall be as specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 AIR RELEASE VALVES

- A. For Water Service and Reclaimed Water Service
  - 1. General: Water mains shall be equipped with combination air release valves located as shown on the Drawings. Valves shall be made to remove air at high points where elevation changes exceed 5-feet. Automatic air release valves shall be located at high points for pipe systems greater than 12-inches in diameter.

2. Water and Reclaimed Water Combination Air Release Valves: The valve body shall be 316 stainless steel, 316 stainless steel float, bronze water diffuser Buna-N or Viton seat and stainless steel trim.
3. Fittings from the main to the air release valve shall be threaded and made of brass.

B. For Wastewater Service

1. General: Wastewater force mains shall be equipped with combination air release valves located as shown on the Drawings. Valves shall be made to remove air at high points where elevation change is 2-feet or greater, located in an enclosure as detailed on the Drawings.
2. Wastewater Combination Air Release Valves: The valve body shall be conical in shape and shall be 316 stainless steel with a funnel shape lower body to automatically drain sewage back into the system. All internal parts shall be corrosion resistant 316 stainless steel or non-metallic plastic materials.
3. On flanged connections 316 stainless steel bolts, nuts and washers are to be used along with the proper sized gasket.

C. Air release valves shall be installed in an enclosure.

## 2.03 TAPPING SLEEVES AND VALVES

A. General: Tapping sleeves shall be mechanical joint sleeves.

B. Mechanical Joint Sleeves: Sleeves shall be cast of gray-iron or ductile-iron and have an outlet flange with the dimensions of the Class 125 flanges shown in ANSI B16.1 and properly recessed for tapping valve. Glands shall be gray-iron or ductile iron. Gaskets shall be vulcanized natural or synthetic rubber. Bolts and nuts shall comply with ANSI/AWWA C111/ANSI A21.11. Sleeves shall be capable of withstanding a 200-psi working pressure.

C. Fabricated Mechanical Joint Tapping Sleeves: Sleeves shall be of split mechanical joint design with separate end and side gaskets. Sleeves shall be fabricated of high strength steel, meeting ASTM A283 Grade C or ASTM A-36. Outlet flange shall meet AWWA C-207, Class "D" ANSI 150-pound drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength low alloy steel to AWWA C111 (ANSI A21.11). Gasket shall be vulcanized natural or synthetic rubber. Sleeve shall have manufacturer applied fusion-bonded epoxy coating, minimum 12-mil thickness.

D. Tapping Valves: Tapping valves shall be resilient seated gate valves flange by mechanical joint ends. Valves shall be compatible with tapping sleeves as specified above and specifically designed for pressure connection operations.

1. Tapping valves with alignment lip shall be placed vertical where possible for Water and Reclaimed Water.

2. Tapping Valves 16-inch and larger shall be AWWA C515 resilient seated only (16-inch and 24-inch no gearing required) above 24-inch shall be installed vertically with a spur gear actuator. When tapping existing mains, valves 24-inch and above shall be furnished with NPT pipe plugs for flushing the tracks.

#### 2.04 VALVE BOXES FOR BURIED VALVES

- A. Standard 2-piece Cast Iron Valve Box: Required for mains less than 6-feet below finished grade and less than or equal to 12-inches in diameter.
  1. Valve boxes shall be provided with suitable heavy bonnets and shall extend to such elevation at or slightly above the finished grade surface as directed by the County's Representative.
  2. The barrel shall be 2-piece, screw type only, having 5-1/4-inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with locking cast iron covers. Coat buried cast iron pieces with coal tar epoxy.
- B. Valve Box Assembly: Valve box assemblies with operating nut extension is required for any size main that is 6-feet or greater below finished grade or if mains are greater than 12-inches in diameter.
  1. Valve boxes shall be 1 complete assembled unit composed of the valve box and extension stem that attaches and locks to the 2-inch wrench nut. The extension shall be high strength, corrosion resistant steel construction, and permanently attached to the operating nut.
  2. The operating nut extension insert shall be 1 complete assembled unit with a self-adjusting extension stem system that fits inside a standard valve box that will accommodate variable trench depths 6-feet and greater as shown in the Drawings. All moving parts of the extension stem shall be enclosed in a housing to prevent contact with the soil.
  3. A valve box-centering device designed to eliminate the shifting of the valve box against the operating nut of the valve shall be used. Valve box assembly shall be adjustable to accommodate variable trench depths 6-foot and greater as shown in the Drawings.
- C. The stem assembly shall be of a telescoping design that allows for variable adjustment length. The material shall be at minimum galvanized square steel tubing. The stem assembly shall have a built-in device that prevents the stem assembly from disengaging at its fully extended length. The extension stem must be capable of surviving a torque test to 1,000-foot-pounds without failure.
- D. Valve boxes shall have locking cast iron covers utilizing a 5-sided nut with a special wrench needed to open. Covers shall have "WATER", "SEWER", or "RECLAIMED WATER" cast into the top, as applicable
- E. Concrete Collar: Each valve installed in an unimproved area (outside of pavement, driveways or sidewalks) shall require a 24-inch by 24-inch by 6-inch concrete pad or collar as shown in the Drawings.

- F. Identification Disc: Each 16-inch or larger valve (unless otherwise shown on the Drawings) installed shall be identified by a 3-inch diameter bronze disc anchored in the concrete pad or collar in unimproved areas and/or anchored on a 4-inch by 4-inch by 18-inch long concrete post set flush with the pavement surface in improved areas. The disc shall be stamped with the following information as shown on the Drawings:
  - 1. Size of the valve
  - 2. Type of valve
  - 3. Service
  - 4. Direction and number of turns to open
- G. Valve markers are to be made of schedule 80 PVC and have decal applied containing information as shown on the Drawings. The marker shall be the same color as the pipe being marked.

## 2.05 LINE STOPPING ASSEMBLIES

- A. Sleeves used to line-stop existing mains shall be provided and installed at locations as shown on the Drawings. Line-stopping sleeve shall be steel fusion epoxy coated body with stainless steel straps, bolts, nuts, and washers. Contractor shall determine the outside diameter of the existing main prior to ordering sleeve.
- B. The line-stopping equipment shall consist of a resilient sealing element, which shall be attached to and transported by a plug inserter perpendicularly into the pipe. The linear actuator shall extend and retract the Line-Stopper into and out of the pipe. When retracted from the pipe, the element and inserter shall be contained within the stopper housing.
- C. The hollow cylindrical sealing element shall be molded of natural rubber. The lower interior chamber of the element shall be enlarged into a hemispherical cavity to allow symmetrical deformation into sealing conformity with the bore of the pipe.
- D. The linear actuator shall be hydraulic and shall have a self-contained hand operated pump. The actuator shall exert a force sufficient to perpendicularly deform the cylindrical element into axially symmetrical sealing contact with the bore of the pipe. Design of actuator shall provide adequate stroke and means to continually align the line-stop bullet stopping assemblies in sizes 14-inch through 20-inch with pressure rating to 250-psig.
- E. Equalization of pressure across the sealed element shall not be required to retract the element from the pipe. No equalization fittings shall be required downstream of the line-stopper.
- F. The line-stopping equipment shall be accurately aligned on the 4-inch through 8-inch fittings by locating in the external threads of the fitting nozzle. With sizes 10-inch and 12-inch the location shall be made on the centering groove of the fitting flange.
- G. Line-stopping equipment must be capable of function and acceptance of multiple stopper heads and shall be compatible with existing system fittings.



## 2.06 FIRE HYDRANTS AND VALVE ASSEMBLIES

- A. Fire hydrants shall be 5-1/4-inch minimum valve opening and shall comply with the current AWWA Standard Specifications C502-54 for 150-psi working pressure. Fire hydrants shall be of ample length for 3-1/2-foot depth of bury with necessary extensions to place safety flange the required 3-inches above finished grade. Each hydrant shall be made in at least 2 sections bolted together. All interior working parts of the hydrant shall be removable from the top of the hydrant to allow repairs without removing the hydrant barrel after it has been installed. It shall be provided with 2 (two) 2-1/2-inch hose nozzles and 1 (one) 4-1/2-inch pumper nozzle, all having its specific Fire District Standard hose threads. All nozzles shall have caps attached by chains. Operating nuts shall be AWWA Standard. Drain or weep holes shall be permanently plugged by the manufacturer.
- B. Fire hydrant painting and coating shall meet the requirements of Section 09900 "Painting." Fire hydrants shall be painted silver in accordance with the present Orange County standards. Three (3) operating wrenches shall be furnished for every 10 hydrants installed or relocated.
- C. All hydrant assemblies shall incorporate anchoring hydrant fittings, including M.J. Locked Hydrant Tee with split gland to provide the locking together of the entire assembly. Gate valve shall be as specified in Specification Section 15111 "Plug Valves."
- D. All hydrants shall have a 24-inch to 48-inch square by 6-inch thick reinforced concrete shear pad as shown in the Drawings.
- E. Fire hydrants shall be located in the general location as shown on the Drawings. Final field location of all hydrants shall be as approved by the County. All hydrants shall be located no less than 5 and no more than 10-feet from the edge of pavement of the adjacent roadway and no less than 5-feet from any physical feature which may obstruct access or view of any hydrant unless otherwise approved by the County.

## 2.07 SERVICE SADDLES

- A. Stainless Steel Service Saddles: Shall be epoxy or nylon coated ductile iron body with stainless steel, 18-8 type 304 straps, AWWA tapered threads for 1-inch and 2-inch to be iron pipe threads. Controlled OD saddles to be used on C905 PVC pipe, double straps to be 2-inch minimum width each, single strap to be minimum of 3-inches wide.
- B. PVC Pipe Service Saddle
  1. One-inch and 2-inch services utilize brass body saddle with controlled OD for 12-inches and smaller pipe.
  2. One-inch and 2-inch taps on existing pipes larger than 12-inches shall use controlled OD epoxy or nylon coated ductile iron body with stainless steel 18-8 type 304 straps.
  3. Four-inch or larger services shall be mechanical tapping sleeves.
- C. Ductile Iron Pipe Service Saddle
  1. One-inch services shall be direct tapped.

2. Two-inch service shall use a controlled OD service tapping saddle with stainless steel straps and a ductile iron body that is either nylon or epoxy coated
3. Four-inch or larger services shall be mechanical tapping sleeves.

D. HDPE Pipe Service Saddle

1. One-inch and 2-inch shall utilize controlled O.D. tapping saddle with epoxy or nylon coated stainless steel 18-8 type 304 double straps.
2. Four-inch or larger, shall use wide body tapping sleeves with a broad cross section gasket set in a retaining groove that increases sealing capability as pressure increases.

E. Concrete Pressure Pipe Service Saddle

1. Tapped concrete pressure pipe shall be in accordance with AWWA M-9, using a strap-type saddle made specifically for concrete cylinder pressure pipe.

F. Steel Pipe Service Saddle

1. Welded-on steel sleeves shall be used for all sizes and applications.

## 2.08 CORPORATION STOPS AND CURB STOPS

- A. Corporation Stops: Shall be brass body reduced port type compatible with the polyethylene tubing and threaded in accordance with AWWA C800, AWWA C901, and shall comply with NSF-61.
- B. Curb Stops: Shall be brass body reduced port type compatible with the polyethylene tubing and threaded in accordance with AWWA C800, AWWA C901, and shall comply with NSF-61.

## 2.09 WATER MAIN AND RECLAIMED WATER MAIN SERVICE PIPE

- A. Polyethylene Service Pipe: One-inch and 2-inch service lines shall be polyethylene tubing conforming to AWWA C901 and AWWA C800. Tubing shall be approved for potable water use and bear the seal of the National Sanitation Foundation (NSF). The product shall be rated for a minimum working pressure of 150-psi and a (Dimension Ratio) DR-9 size. The tubing shall be designated copper tube size and the material PE-2406 cell classification minimum PE213323C in accordance with ASTM 3350.
- B. Ductile Iron Service Pipe: Services 4-inch and larger shall be DIP. If the existing main is on the same side of the street as the property to be serviced, the service pipe shall be DIP from the point of connection to the existing main to the meter assembly. If the existing main is on the opposite side of the street as the property to be serviced, at a minimum, the segment of pipe immediately upstream from the meter assembly shall be DIP.
- C. No service pipe shall terminate under a driveway.

## 2.10 PRESSURE GAUGES

- A. Pressure gauges shall be installed on each pump station discharge pipe as indicated on the Drawings.
- B. Pressure gauge shall be direct mounted, diaphragm (type) gauge, stainless steel case, stainless steel sensing element, liquid filled, with a 4-1/2-inch diameter dial and furnished with a clear glass crystal window and 1/4-inch shut-off (isolation) valve. Gauges shall be weatherproof.
- C. The pressure gauge face dial shall be white finished aluminum with jet-black graduations and figures and shall indicate the units of pressure measured in psi. Gauges shall be provided with pressure at normal operation at the mid range of the gauge.
- D. As wastewater flows through the housing, the cylinder shall transmit pressure through the sensing liquid. Gauge outlet in the spool or ring shall be threaded, 1/4-inch, per ANSI B2.1.
- E. Nipples for connecting gauges to piping shall be Schedule 80S, Grade TP 316 seamless stainless steel, conforming to ASTM A 312. Fittings shall conform to ASTM A 403, Class WP316. Threads shall conform to ANSI B2.1. Size of pipe nipple shall match the gauge connection size.

## 2.11 TIE RODS

- A. Steel for tie rods and tie bolts shall conform to the requirements of ASTM Designation A 242, and rods shall be galvanized in conformance with requirements of ASTM Designation A 123.

## 2.12 BACK FLOW PREVENTION

- A. Reduced Pressure Backflow Preventer shall conform to the requirements of ASSE 1013, rated to 180°F and supplied with full port ball valves. The main body and access covers shall be bronze and meet ASTM B 584, the seat ring and all internal polymers shall be NSF Noryl and the seat disc elastomers shall be silicone.
- B. Dual check valves shall be required and shall be accessible for maintenance without removing the relief valve or the entire device from the line.
- C. The bottom of the preventer shall be installed a minimum of 12-inches above grade and not more than 30-inches above grade.

## 2.13 FLANGED COUPLING ADAPTERS

- A. All adapters shall be harnessed with the bolts across the joint (flange to flange or flange to lug) designed for the pipe test pressure.

- B. Adapter Size: Conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125 or 150-pound standard unless otherwise required for connections.
- C. Exposed Sleeve Type
  - 1. Material: Steel
  - 2. Coating: Enamel
  - 3. Bolting: Carbon steel
  - 4. Acceptable Manufacturers: Dresser Manufacturing Co. - Style 128 for cast iron ductile iron and steel pipes with diameters of 2-inches through 96-inches, or equal.
- D. Buried Sleeve Type
  - 1. Material: Cast iron
  - 2. Bolting: Type 304 stainless steel conforming to ASTM A 193, Grade B8 for bolts, and ATM A 194, Grade 8 for nuts and washers. Bolts and nuts greater than 1-1/8-inches shall be carbon steel, ASTM A 307, Grade B, with cadmium plating, ASTM A 165, Type NS.
  - 3. Acceptable manufacturers: Dresser Manufacturing Co. - Style 127 locking type for cast iron, ductile, iron, asbestos cement and steel pipes with diameters of 3-inches through 12-inches, or equal.
- E. Split Type
  - 1. Material: Malleable or ductile iron.
  - 2. Design: For use with grooved or shouldered end pipe.
  - 3. Coating: Enamel
  - 4. Acceptable Manufacturers: Victaulic Company of America - Style 741 for pipe diameters of 2-inches through 12-inches, Victaulic Company of America - Style 742 for pipe diameters of 14-inches through 16-inches, or equal.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. All ancillary equipment shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the County before installation.
- B. After installation, all ancillary equipment shall be tested as specified for adjacent piping. If any joint or equipment proves to be defective, it shall be repaired and retested to the satisfaction of the County.
- C. 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 the location and shall be responsible for the proper location of these valves and appurtenances during the Construction of the structures.

D. Notification and Connections to Existing Mains

1. The Contractor shall submit a completed "System Connection" form to the County to schedule the connection. The request shall be made a minimum of 5-working days prior to the proposed tie-in to the existing main for pressure connections and 10-working days prior to the proposed tie-in to the existing main for non-pressure connections. In this request, the Contractor shall provide the following information:
  - a. Points of connection, fittings to be used and method of flushing and disinfection if applicable
  - b. Estimated construction time for said connections
  - c. Identify pressure and non-pressure connections
2. Connections shall only be made on the agreed upon date and time. If the Contractor does not perform the Work in the agreed upon manner or schedule, the Contractor shall be required to reschedule the connection by following the procedure outlined above.

E. Pressure Connections: Sufficient length of main shall be exposed to allow for installation of the tapping sleeve and valve and the operation of the tapping machinery. The main shall be supported on concrete pedestals or bedding rock at sufficient intervals to properly carry its own weight, plus the weight of the tapping sleeve, valve and machinery. Any damage to the main due to improper or insufficient supports will be repaired at the Contractor's expense.

1. Prior to the tap, the Contractor shall assemble all materials, tools, equipment, labor, and supervision necessary to make the connection.
2. The Contractor shall excavate a dry and safe working area pit of sufficient size to enable the necessary Work.
3. The inside of the tapping sleeve and valve, the outside of the main and the tapping machine shall be cleaned and swabbed or sprayed with 1% liquid chlorine solution prior to beginning installation for water system pressure connections and must comply with AWWA C-651-99 or most current version.
4. After the tapping sleeve has been mounted on the main, the tapping valve shall be bolted to the outlet flange, making a pressure tight connection. Prior to beginning the tapping operation, the sleeve and valve shall be pressure tested under the observation of County personnel to 150-psi for 30-minute duration to ensure that no leakage will occur.
5. For pressure connections 4-inch through 20-inch installation, the minimum diameter cut shall be 1/2-inch less than the nominal diameter of the pipe to be attached. For larger taps, the allowable minimum diameter shall be 2 to 3-inches less than the nominal diameter of the pipe being attached. After the tapping procedure is complete, the Contractor shall submit the coupon to the County.
6. The tapping valve shall be placed horizontally for pressure connections to wastewater force mains. A plug valve shall be attached to the tapping valve after the tapping procedure is complete. The tapping valve shall be left in the open position prior to backfilling.
7. Adequate restrained joint fittings shall be provided to prevent movement of the installation when test pressure is applied.
8. The Contractor shall be responsible for properly backfilling the work area pit after the Work is completed.

F. Non-Pressure Dry Connections

1. For water service connections, no customer shall be without service for more than 6-hours. For wastewater connections, provide bypass operations per Section 01516 "Collection System Bypass." This accommodation to customers may include scheduling after Normal Working Hours.
2. The Contractor shall be ready to proceed by pre-assembling as much material as possible at the site to minimize the length of service interruption.
3. Needed pipe restraints must be installed prior to the initiation of the shutdown.
4. The excavation shall be opened and needed site preparations must be completed before the initiation of the connection work.
5. County shall postpone a service cut-off if the Contractor is not ready to proceed at the scheduled time.
6. Only County personnel shall operate the valves needed to perform the shutdown on the existing system.

3.02 PAINTING

- A. All exterior surfaces of iron body valves shall be clean, dry, and free from rust and grease before coating.
- B. For valves installed underground or in valve vaults, all exterior ferrous parts of valve and actuator shall be coated at the factory with a thermally bonded epoxy coating in accordance with AWWA C550, latest revision.
- C. For aboveground service, the exterior ferrous parts of all valves shall be coated in weatherproof paint. The color of the finish coats shall be in accordance with the Orange County Utilities Standards.

END OF SECTION

**SECTION 15102**  
**DUCTILE IRON PIPE AND FITTINGS**

**PART 1 – GENERAL**

1.01 DESCRIPTION

- A. Scope of Work: Furnish all labor, materials, equipment and incidentals required and install in the locations as shown on the Drawings, all restrained ductile iron piping, restrained ductile iron fittings, and appurtenances as specified herein.
  
- B. Design:
  - 1. General: The equipment and materials specified herein is intended to be standard types of ductile iron pipe and ductile iron fittings for use in transporting sewage, sludges, water, and reclaimed water.
  - 2. Criteria:
    - a. Pipe shall be designed for a design working pressure of 200 psi with an additional surge pressure of 100 psi for a total working plus surge pressure of 300 psi.
    - b. Live loads shall be calculated using HS 20 Highway Loads.
    - c. Dead loads shall be calculated using 120 lb. per cubic ft. soil.
    - d. A 60° bedding angle shall be used for deflection and bending moment calculations. Soil E<sup>1</sup> shall be no more than 1000.

1.02 QUALITY ASSURANCE

- A. Qualifications: All of the ductile iron pipe and ductile iron fittings shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed, installed in accordance with the best practices and methods and shall comply with these Technical Special Provisions as applicable.
  
- B. Standards:
  - 1. ANSI A 21.50/AWWA C150
  - 2. ANSI A-21.51/AWWA C151
  - 3. ANSI A-21.4/AWWA C104
  - 4. ANSI A-21.10/AWWA C110
  - 5. ANSI A-21.53/AWWA C153
  - 6. ANSI A-21.5/AWWA C105
  - 7. AWWA C600
  - 8. AWWA C651

C. Factory Tests: The manufacturer shall perform the factory tests described in ANSI A-21.51/AWWA C151.

D. Quality Control:

1. The manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with the referenced standards.
2. In addition to the manufacturer's quality control procedures, the Owner may select an independent testing laboratory to inspect the material at the foundry for compliance with these Technical Special Provisions. The cost of foundry inspection requested by the Owner will be paid for by the Owner.

### 1.03 SUBMITTALS

A. Materials and Shop Drawings: Submit shop drawings, including pipeline layouts, within and under buildings and structures. Shop drawings shall include dimensioning, methods and locations of supports and all other pertinent technical specifications. Shop drawings shall be prepared by the pipe manufacturer. Shop drawings for piping within and under buildings and structures shall be submitted within 30 days of Execution of Contract.

B. Operating Instructions: Submit Operation and Maintenance Manuals in accordance with Division 1.

C. Manufacturer's Certification: Submit certification of compliance with the following, sworn by a corporate officer of the manufacturer and witnessed by a notary:

1. Specified factory tests and results
2. Dimensions and weights of fittings per respective AWWA Standard.

### 1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with the manufacturer's recommendations and with DIPRA's "Guide for the Installation of Ductile Iron Pipe".

B. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe or fittings and their respective coatings. Pipe or fittings shall not be rolled off the carrier or dropped. Unloading shall be done by lifting with a forklift or crane. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.

## **PART 2 – PRODUCTS**

### 2.01 MATERIALS

All materials furnished for this project shall be in accordance with the “List of Approved Products” as appended to these specifications.



A. Ductile Iron Pipe:

1. Standards: ANSI A-21.50, AWWA C150 and ANSI A-21.51, AWWA C151.
2. Thickness:
  - a. Below Ground Piping: Pipes shall be the following minimum thickness class unless otherwise noted or specified.
    - 1) 12-inch or smaller (unless otherwise noted or specified) Class 350
    - 2) 16-24 inch diameter Class 250
    - 3) 30-64 inch diameter Class 200
    - 4) 30 to 64-inch diameter Class 200
  - b. Above Ground Piping
    - 1) Flanged, Class 53 (Minimum)
  - c. Lengths: Supply pipe in lengths not in excess of 20 feet.
3. Joints:
  - a. Push-on or Mechanical Joints (below ground piping):
    - 1) Standards: ANSI A21.11/AWWA C111
    - 2) Class: The working pressure of the joint shall be equal to or exceed the rated working pressure of the pipe.
    - 3) Gaskets: SBR (Styrene Butadine Rubber)
  - b. Flanged (above ground or inside below ground vaults):
    - 1) Standards: ANSI A21.15, ANSI B16.1
    - 2) Class: 125 lb factory applied screwed long hub flanges, plain faced without projection.
    - 3) Gaskets:
      - a) Spans less than 10 feet: full face 1/8-inch thick neoprene rubber.
      - b) Spans greater than 10 feet: Toroseal gaskets as manufactured by American Cast Iron Pipe or equal.
  - c. Restrained Joints:
    - 1) Restrained Gaskets: "Fast-Grip" as manufactured by American Ductile Iron Pipe, "Field Lok" as manufactured by U.S. Pipe or equal; May be used for: Straight runs of pipe for sizes 2-inch through 24-inch.
    - 2) Mechanically Restrained Joints:
      - a) "Manufactured" Restrained Joints: "Flex-Ring" or "Lok-Ring" restrained joint system as manufactured by American Ductile Iron Pipe, "TR-Flex" restrained joint system as manufactured by U.S. Pipe or equal; May be used for: (1) Straight runs of pipe, (2) Within bore and jackcasings (3) Aerial bridge crossings.
      - b) "Mechanical" Joint Pipe with Restraining Devices: Meg-a-Lug system as manufactured by EBBA Iron or equal; May be used for: (1) Straight runs of pipe, (2) Within bore and jack casings, (3) Aerial bridge crossings, (4) Fittings.
    - 3) Class: 250 psi (minimum) design pressure rating
    - 4) Standard mechanical joint retainer glands will not be acceptable.
  - d. Joint Accessories:
    - 1) Mechanical joint bolts, washers, and nuts: Carbon steel.

- 2) Flanged joint bolts, washers and nuts: Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts and ASTM A 194, Grade 8M for nuts.
- e. Pipe Length (below ground installation): 20 feet maximum nominal length.

B. Fittings:

- 1. Materials: Ductile iron, AWWA C 110 and/or AWWA C 153.
- 2. Pressure Class:
  - a. Mechanical Joint: 2-inch through 24-inch fittings shall be pressure rated at 350 psi minimum. All 30-inch and larger fittings shall be pressure rated at 250 psi minimum.
  - b. Flanged Joint: Minimum 250 psi pressure rating, Class 125, plain.
- 3. Grooved-End Couplings:
  - a. Grooved-end pipe couplings shall be malleable iron, ASTM A47 (Grade 32510), or ductile iron, ASTM A536 (Grade 65-45-12).
  - b. Bolts: ASTM A 183, 110,000-psi tensile strength
  - c. Gaskets: Halogenated butyl rubber or EPDM for water service and Buna-N for sewage service, conforming to ASTM D2000.
  - d. Couplings: AWWA C606 for rigid radius ductile-iron pipe. Couplings shall be Victaulic Style 31, Gustin-Bacon No. 500, or equal.
  - e. Grooved-end adapter flanges for piping having an operating pressure of 150 psi and less shall be Victaulic Style 341, or equal. Flange dimensions shall conform to ANSI B16.1 Class 125.

C. Wall Penetrations:

- 1. Wall Pipes:
  - a. Material: Ductile iron or cast iron
  - b. Type: Integrally cast wall collar/water stop located in the center of the wall.
  - c. Design: Full thrust at 250 psi transmitted to the structure wall. Tapped mechanical joint wall pipes may be used to facilitate concrete form work.
- 2. Wall Sleeves:
  - a. Material: Galvanized Schedule 40 Steel Pipe, ASTM A120
  - b. Design: as manufactured by Thunderline Corporation, "Link Seal" or equal.

2.02 COATINGS, MARKINGS, AND LININGS

A. Exterior Coatings:

- 1. Below Ground or in a Casing Pipe:
  - a. Type: Asphaltic coating, 1.0 mil DFT in accordance with ANSI/AWWA A21.51/C151.
  - b. Markings: All buried ductile iron pipe shall be marked with a continuous stripe located within the top 90 degrees of the pipe. Said stripe shall be a minimum 3-inch in width and shall be oil based paint, blue in color. Backfill shall not be placed for 30 minutes following paint application. At the Contractor's option, the pipe may be stripe marked prior to pipe installation as follows:
 

Up to 8-inch diameter:	(2) 3-inch wide @ 180°
10 to 16-inch diameter:	(3) 3-inch wide @ 120°

- 18 to 24-inch diameter: (4) 3-inch wide @ 90°
  - 30 to 54-inch diameter: (6) 3-inch wide @ 60°
  - c. Color: Potable Water: Blue  
Wastewater: Green  
Reclaimed Water: Purple
  - 2. Aboveground:
    - a. Not subject to non-potable water submergence or splashing: See Division 9.
    - b. Subject to non-potable water submergence or splashing: See Division 9.
    - c. Color: See Division 9
- B. Interior Lining:
- 1. Wastewater: Factory applied protective coating of Protecto 401. Lining material shall be 40 mils nominal thickness. The number of coats of lining material applied shall be as recommended by the lining manufacturer.
  - 2. Water and Reclaimed Water: Cement mortar lining with a seal coat of asphaltic material in accordance with ANSI/AWWA A21.4/C104.
- C. Polyethylene Encasement: HDPE cross laminated polyethylene prefabricated sleeves with UV inhibitors taped to DIP with polyethylene tape, and installed per Method A (AWWA C105).
- 1. Required for all below ground piping, fittings, and appurtenances.
    - a. Located less than 10 feet from a gas main.
    - b. As indicated on the Drawings.
  - 2. Standard: ANSI A 21.5/AWWA C105, 8 mil minimum thickness.
  - 3. Color: Color coded per paragraph A.1 above.
- D. Location Detection Wire:
- 1. Materials: Continuous, color coded insulated single strand solid 10 gauge copper wire.
  - 2. Installation: Attached directly to the pipe along the centerline with nylon wire ties as shown in the Drawings.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Standards: AWWA C600-87.
- B. Underground Ductile Iron Pipe and Fittings:
  - 1. Bedding: Firm, dry and even bearing of suitable material. Blocking under the pipe will not be permitted.
  - 2. Placement:
    - a. Alignment: In accordance with lines and grades shown on the Drawings. Deflection of joints shall not exceed 75 percent of that recommended by the manufacturer.

- b. Polyethylene Encasement: Provide polyethylene wrap around piping, fittings and appurtenances located less than 10 feet from a gas main and as indicated on the Drawings.
  - 3. Cutting: When required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of the pipe to be used with a push-on bell shall be beveled.
  - 4. Joints:
    - a. Joint Placement:
      - 1) Push on joints: Pipe shall be laid with the bell ends facing upstream. The gasket shall be inserted and the joint surfaces cleaned and lubricated prior to placement of the pipe. After joining the pipe, a metal feeler shall be used to verify that the gasket is correctly located.
      - 2) Mechanical Joints: Pipe and fittings shall be installed in accordance with the "Notes on Method of Installation" under ANSI A21.11/AWWA C111. The gasket shall be inserted and the joint surfaces cleaned and lubricated with soapy water before tightening the bolts to the specified torque.
      - 3) Grooved-End Joints:
        - a) Install grooved end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following.
        - b) Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove before installing coupling. Apply the coupling manufacturer's gasket lubricant to the gasket exterior, including lips, pipe ends, and housing interiors.
        - c) Fasten coupling alternately and evenly until coupling halves are seated. Use torques as recommended by the coupling manufacturer.

### C. Above Ground and Interior Ductile Iron Pipe and Fittings

- 1. Pipe Supports:
  - a. General: All piping shall be properly supported with hangers, supports, base elbows and tees, concrete piers and pads as shown on the Drawings. All pipe and appurtenances connected to equipment shall be supported to prevent any strain from being imposed on the equipment.
  - b. Support Spacing: 8 feet on centers and at each fitting and where shown on the Drawings.
  - c. Hangers for Horizontal Piping:
    - 1) Material: Heavy malleable iron.
    - 2) Type: Adjustable, swivel, split ring or adjustable swivel, pipe-roll.
  - d. Hangers for Vertical Piping:
    - 1) Material: Wrought Iron.
    - 2) Type: Clamp.
- 2. Placement:
  - a. Alignment: In accordance with lines and grades shown on the Drawings. Each section of pipe shall be cleaned thoroughly prior to installation.
- 3. Flanged Joints: Joints shall be fitted so that the contact faces bear uniformly on the gasket.

D. Thrust Restraint:

1. General: Thrust restraint shall be accomplished by restrained joints.
2. All underground pipe joints (mechanical or push-on) shall be restrained.

E. Thrust Blocks: Thrust blocks shall not be allowed.

3.02 CLEANING

- A. General: At the conclusion of the work, the Contractor shall thoroughly clean the new pipe lines by flushing with water or other means to remove all dirt, stones, or other material which may have entered the line during the construction period.
- B. Correction of Non-Conforming Work: All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the Owner. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of this Project Manual and/or the drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, visible or detectable leakage and failure to pass any specified test or inspection.

3.03 FIELD TESTING

- A. General: At least ten (10) days prior to beginning testing, the Contractor shall submit a testing plan to the Engineer for review.
- B. Gravity Piping: The Contractor shall perform low pressure air test on all gravity piping.
- C. Pressure Piping: The Contractor shall perform hydrostatic pressure and leakage tests on all pressure piping. Test in accordance with Section 02535 for testing wastewater and reclaimed water mains, and Section 02510 for testing potable water mains.

3.04 DISINFECTING POTABLE WATER PIPELINES

- A. General: Before being placed in service, all potable water pipelines shall be disinfected by chlorination. Taps for chlorination and sampling shall be uncovered and backfilled by the Contractor as required. The disinfection procedure shall be approved by the Engineer
- B. Test in accordance with Section 02510 – 3.05.
- C. Dispose of chlorinated water in accordance with Section 02510 – 3.08.

END OF SECTION

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## **SECTION 15111**

### **ELECTRONIC CONTROL VALVE**

#### **PART 1 - GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Scope of Work: Furnish and install an electronic control valve in the location as shown on the Drawings and/or specified herein.
- B. General Design:
  - 1. Comply with the requirements of Section 15000.
  - 2. The electronic control valve shall control flow, pressure, and GST water level. The electronic controller shall enable remote computer control over valve operations.

##### **1.02 QUALITY ASSURANCE**

- A. Qualifications: See Section 15000.
- B. Standards: See Section 15000.
- C. Warranty: See Section 15000.
- D. Equipment Manufacturers: Manufacturer shall be Cla-Val or approved equal.

##### **1.03 SUBMITTALS**

- A. General: Submittals shall be in accordance with Section 01300.

##### **1.04 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. General: Product delivery, storage and handling shall be in accordance with Section 15000.

##### **1.05 SPECIAL TOOLS AND SPARE PARTS**

- A. General: Provide special tools in accordance with Section 15000.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. General: All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

### **2.02 MATERIALS**

#### **A. Main Valve**

1. The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearing installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

#### **B. Main Valve Body**

1. No separate embers shall be allowed between the main valve cover and body. Valve body and cover shall be ductile iron. No fabrication or welding shall be used in the manufacturing process.
2. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hour-glass shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.
3. The diaphragm assembly containing a non-magnetic Type 303 stainless steel stem; of sufficient diameter to withstand high hydraulic pressures, shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.
4. The flexible, non-wicking, NSF 61 approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a



- Mullins Burst Test of a minimum of 600 x per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.
5. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted and components including cast material shall be of North American manufacture.
  6. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.
  7. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.
  8. The main valve stem shall include outdoor rated limit switches for indication of open or closed position for remote monitoring by the SCADA system.

#### C. Pilot Control System

1. The hydraulic control valve pilot system shall consist of dual solenoids which alternately apply or relieve pressure to the diaphragm chamber to position the main valve. They shall be normally closed (energized to open), 120 volt AC with Nema type 4 enclosure. A manual system to by-pass the solenoids shall also be provided.

#### D. Electronic Valve Controller

2. The operator keypad shall consist of two rows of alphanumeric characters to display numeric values and units. Color-coded alarm, status and mode indicators will display operating conditions. Security key codes shall protect against unauthorized changes to the controller. All programming shall include key words and prompts to aid in set-up and timing the controller. Valve controller shall be a 131VC series controller or approved equal.
3. The controller shall be solid-state construction with an internal chassis capable of being removed for inspection and repair. All program memory including set-point and timing parameters shall be protected by an internal lithium battery rated for 10 year life.
4. Controller Specifications  
Control Input: 4-20 mA full scale

Control Parameters:

Proportional Bands: 1-200% adjustable in 1% increments independently for opening and closing.

Deadband: Adjustable 0.00 to 25.5% of span.

Cycle Time: 1 to 60 seconds in 1 sec. increments.

5. Environmental Parameters:

Temperature: 5 C to 55 C (40 F to 130 F)

Humidity: 90% RH, non-condensing.

Power Input: 13.5 watts max. at 110 VAC, 50/60 Hz.

Memory Protection: 10 yr. type. life lithium battery

Housing: Flame retardant UL rated ABS plastic. Fits 1/4 DIN cutout.

A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Valves shall be installed in the locations shown, true to alignment and rigidly supported. Install valves with stem position vertical, unless shown otherwise.
- B. Allow sufficient clearance around valve operator for proper operation and maintenance.
- C. Install in accordance with Section 15000.
- D. After installation, all ancillary equipment shall be tested as specified for adjacent piping. If any joint or equipment proves to be defective, it shall be repaired and retested to the satisfaction of the County.

#### **3.02 PAINTING**

- A. All exterior surfaces of iron body valves shall be clean, dry, and free from rust and grease before coating.
- B. For valves installed underground or in valve vaults, all exterior ferrous parts of valve and actuator shall be coated at the factory with a thermally bonded epoxy coating in accordance with AWWA C550, latest revision.
- C. For aboveground service, the exterior ferrous parts of all valves shall be coated in weatherproof paint. The color of the finish coats shall be in accordance with the Orange County Utilities Standards.

END OF SECTION

**SECTION 15126**  
**PIPE HANGERS AND SUPPORTS**

**PART 1 – GENERAL**

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish all labor, materials, equipment, and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

B. Related Work Described Elsewhere:

1. Concrete is included in Division 3.
2. Metal fabrications are included in Section 05500.
3. Painting is included in Section 09900.
4. Pipe and fittings are included in respective sections of Division 15.
5. Mechanical – General Requirements: Section 15000.

C. General Design (Not Applicable)

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 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 compliance with such requirements.

1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. Submit to the Engineer for approval, as provided in the General Conditions and Section 01300, shop drawings of all items to be furnished under this Section.
2. Submit to the Engineer, for approval, samples of all materials specified herein.

1.04 PRODUCT 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 01610: Delivery, Storage, and Handling.

## 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 against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. All pipe supports shall be approved prior to installation.
- B. The Contractor shall select and design all piping support systems within 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 in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the plant.
- 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 supports shall be spaced in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.
- G. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Anvil International, Inc., Carpenter and Patterson, Inc., or approved equal. Any reference to a specific figure number of a specific manufacturer is to establish a type and quality of product and shall not be considered as proprietary. 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 Metal Pipe:

1. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clamps, or ceiling mounting bolts as follows:
  - a. Hangers:

<u>Pipe Size, Inches</u>	<u>Anvil Fig. No.</u>
Less than ½	138R
½ through 1	97C
1¼ through 4	104
6 through 12	590
14 through 30	171

- b. Hanger rods shall be rolled steel machine threaded with load ratings conforming to ASTM Specifications and the strength of the rod shall be based on root diameter. Hanger rods shall have the following minimum diameters:

<u>Pipe Size, Inches Min.</u>	<u>Rod Diameter, In.</u>
Less than 2½	3/8
2½ to 3	½
4	5/8
6	¾
8 to 12	7/8
14 to 18	1

- c. Where applicable, structural attachments shall be beam clamps. Beam clamps, for rod sizes ½-inch through ¾-inch shall be equal to Anvil Fig. No. 229, and for rod sizes 7/8-inch through 1¼-inch shall be equal to Anvil Fig. No. 228, or equal.
      - d. Concrete inserts for pipe hangers shall be; continuous metal inserts designed to be used in ceilings, walls or floors, spot inserts for individual pipe hangers, or ceiling mounting bolts for individual pipe hangers and shall be as manufactured by Unistrut Corp., Wayne, Michigan; Carpenter and Patterson, Inc., Laconia, New Hampshire; Richmond or equal and shall be as follows:
        - 1) Continuous concrete inserts shall be used where applicable and/or as shown on the Drawings and shall be used for hanger rod sizes up to and including ¾-inch diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be Series P3200 by Unistrut Corp., Fig 1480 Type 2 by Carpenter and Patterson, Inc., or equal. Inserts to be used where supports are perpendicular to the main slab reinforcement shall be Series P3300 by Unistrut Corp., Fig. 1480 Type I by Carpenter and Patterson, Inc. or equal.
        - 2) Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8-inch diameter. Inserts shall be Fig. 650 by Carpenter and Patterson, Inc. for hanger rod sizes ½-inch through and including ¾-inch, and Fig. 266 by Carpenter and Patterson Inc., for 7/8-inch hanger rods.
        - 3) Ceiling mounting bolts shall be used where applicable and be for hanger rod sizes 1-inch through and including 1¼-inch and shall be Fig. 104M as manufactured by Carpenter and Patterson, Inc., or equal.

- e. All pipe hangers shall be capable of vertical adjustment under load and after erection. Turnbuckles, as required and where applied, shall be equal to Anvil Fig. No. 230.
- 2. Wall or column supported pipes shall be supported by welded steel brackets equal to Anvil Fig. 194, 195 and 199 as required, for pipe sizes up to and including 20-inch diameter. Additional wall bearing plates shall be provided where required.
  - a. Where the pipe is located above the bracket, the pipe shall be supported by an anchor chair and U-bolt assembly supported by the bracket for pipes 4 inches and larger and by a U-bolt for pipes smaller than 4 inches. Anchor chairs shall be equal to Carpenter Patterson Fig. No. 127. U-bolts shall be equal to Anvil Fig. No. 120 and 137.
  - b. Where the pipe is located below the bracket, the pipes shall be supported by pipe hangers suspended by steel rods from the bracket. Hangers and steel rods shall be as specified above.
- 3. Floor-supported pipes 3-inches and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where lateral displacement of pipes is not probable.
  - a. Each concrete support shall conform to the details shown on the Drawings. Concrete shall be poured after the pipe is in place with temporary supports. Concrete piers shall conform accurately to the bottom  $\frac{1}{3}$  to  $\frac{1}{2}$  of the pipe. Top edges and vertical corners of each concrete support shall have 1-inch bevels. Each pipe shall be secured on each concrete support by a wrought iron or steel anchor strap anchored to the concrete with cast-in-place bolts or with expansion bolts. Where directed by the Engineer, vertical reinforcement bars shall be grouted into drilled holes in the concrete floor to prevent overturning or lateral displacement of the concrete support. Unless otherwise approved by the Engineer, maximum support height shall be five (5) feet.
  - b. Concrete piers used to support base elbows and tees shall be similar to that specified above. Piers may be square or rectangular.
  - c. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size 150 pound companion flanges or slip-on welding flanges respectively. Supporting pipe shall be of Schedule 40 steel pipe construction. Each flange shall be secured to the concrete floor by a minimum of two (2) expansion bolts per flange. Adjustable saddle supports shall be equal to Anvil Fig. No. 264. Where used under base fittings, a suitable flange shall be substituted for the saddle.
- 4. Vertical piping shall be supported as follows:
  - a. Where pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within 2 feet of the change in direction by pipe supports as previously specified herein.
  - b. For vertical runs exceeding 15 feet, pipes shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.

- c. Where vertical piping passes through a steel floor sleeve, the pipe shall be supported by a friction type pipe clamp which is supported by the pipe sleeve. Pipe clamps shall be equal to Anvil Fig. 262.
  5. Anchor bolts shall be equal to Kwik-Bolt as manufactured by the McCulloch Industries, Minneapolis, Minnesota, or Wej-it manufactured by Wej-it Expansion Products, Inc., Bloomfield, Colorado.
  6. All rods, hangers, inserts, brackets, and components shall be furnished with galvanized finish.
- B. Pipe Hangers and Supports for Plastic Pipe:
1. Single plastic pipes shall be supported by pipe supports as previously specified herein.
  2. Multiple, suspended, horizontal plastic pipe runs, where possible, and rubber hose shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy, the Globetray by the Metal Products Division of United States Gypsum, or equal. Ladder shall be of mild steel construction. Rung spacing shall be approximately 18 inches for plastic pipe and 12 inches for rubber hose. Tray width shall be approximately 6-inch for single runs of rubber hose and 12 inches for double runs of rubber hose. Ladder-type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc. required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners equal to Globe Model M-CAC, Husky-Burndy Model SCR or approved equal. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe.
  3. 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.
- C. Pipe Supports for Small Diameter PVC and Steel Pipe:
1. Small diameter Schedule 80 PVC piping 3-inch in diameter and smaller and steel piping 2-inch in diameter and smaller shall be supported with "SUSPORT" system arrangements as manufactured by Universal Suspension Systems Inc. of Gillette, NJ or an Engineer-approved equal. Clamping halves for the pipe support shall be manufactured of molded polypropylene and shall support and fit closely for 360° around the pipe. To support piping carrying non-corrosive fluids or gases and located in noncorrosive, indoor environments, all hardware for the "SUSPORT" system shall be nickel chrome plated carbon steel. To support piping carrying corrosive fluids or gases, piping located in corrosive environments, or piping located outdoors, all hardware for the system shall be manufactured of Type 304 stainless steel.
  2. To adequately support small diameter PVC or steel piping, a metal frame support structure may be required to support the above-specified "SUSPORT" system. Where required, metal frame support structures shall be constructed using channels, fittings, brackets, hardware, and other accessories as manufactured by B-Line Systems, Inc. of Highland, IL, or an Engineer- approved equal. Materials for the frame structure in indoor, non-corrosive environments shall be carbon steel with an epoxy coating applied by a cathodic electro-deposition process equal to "Dura-a-Green" by B-Line Systems, Inc. Materials for the frame structure in corrosive or outdoor environments

shall be Type 316 stainless steel unless otherwise noted on the Drawings. Hardware used to construct the frame support structure shall be cadmium-plated for carbon steel supports or Type 316 stainless steel for stainless steel supports.

3. Pipe supports for small diameter PVC and steel piling shall be located wherever necessary to adequately support the pipe in the Engineer's opinion. They shall have a maximum spacing as specified below for straight pipe runs. Adequate supports shall especially be used adjacent to valves and fittings in pipelines. The following table is based on spacing requirements for Schedule 80 PVC or Standard Weight (Schedule 40) steel pipe carrying a fluid with a Specific Gravity of 1.0 at a temperature not exceeding 120°F. Support spacing for PVC or steel piping carrying fluids exceeding the above-stated Specific Gravities or temperatures shall be Engineer-approved.

Nominal Pipe Diameter, Inches	Support Spacing, Feet	
	PVC Pipe	Steel Pipe
1/2"	3.5	4.5
3/4"	4.0	5.0
1"	4.5	5.5
1 1/4"	5.0	6.5
1 1/2"	5.0	7.5
2"	5.5	8.0
2 1/2"	5.5	-
3"	6.0	-

2.03 ACCESSORIES (NOT APPLICABLE)

2.04 SPARE PARTS (NOT APPLICABLE)

2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for this project.



## **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 submerged pipe supports shall be prime coated with Koppers 654 Epoxy Primer or approved equal. All other pipe supports shall be prime coated with Rustinhibitive Primer No. 621 as manufactured by Koppers Company, Inc., Pittsburgh, Pa., or 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. Pipe supports shall be provided as follows:
  - 1. Cast iron and ductile iron shall be supported at a maximum support spacing of 10 feet, 0-inch with minimum of one support per pipe section at the joints.
  - 2. All vertical pipes shall be supported at each floor or at intervals of at least 15 feet by approved pipe collars, clamps brackets or wall rests, and at all points necessary to insure rigid construction.
- E. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.
- F. Inserts for pipe hangers and supports shall be installed on forms before concrete is poured. Before setting these items, all Drawings and figures shall be checked that have a

direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.

G. Continuous metal inserts shall be embedded flush with the concrete surface.

H. 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.
2. Horizontal Piping Supported From Walls:
  - a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
  - b. Stacked Piping:
    - 1) Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
    - 2) Piping clamps which resist axial movement of pipe through support not acceptable.
  - c. Wall mounted piping clips not acceptable for insulated piping.
3. Horizontal Piping Supported From Floors:
  - a. Stanchion Type:
    - 1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
    - 2) Use yoke saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.
    - 3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
  - b. Floor Mounted Channel Supports:
    - 1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
    - 2) Attach channel framing to floors with anchor bolts.
    - 3) Attach pipe to channel with clips or pipe clamps.
  - c. Concrete Cradles: Use for piping larger than 3-inch along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
5. Standard Attachments:
  - a. To Concrete Ceilings: Concrete inserts.
  - b. To Steel Beams: I-beam clamp or welded attachments.
  - c. To Wooden Beams: Lag screws and angle clips to members not less than 2½-inch thick.
  - d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.

6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

3.03 INSPECTION AND TESTING (NOT APPLICABLE)

3.04 START-UP AND INSTRUCTION (NOT APPLICABLE)

END OF SECTION

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## SECTION 15607

### FUEL OIL SYSTEM FOR STANDBY EMERGENCY POWER

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. This section includes materials, installation and testing of above ground steel fuel piping for standby engine-generator.

##### 1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and the following.
- B. Submit manufacturer's catalogue data, fabrication installation drawings and performance data for above fuel oil piping material, valves, fill caps and other fuel oil system appurtenances, pipe support systems, sleeves, anchor bolt design.

##### 1.03 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications", and ASME B31.3.

##### 1.04 WARRANTY

- A. Special Product Warranty: Submit a written warranty for all proposed equipment, executed by the manufacturer, agreeing to repair the failure, replace the failed equipment, or refund the original purchase price.

##### 1.05 REFERENCES

- A. Materials and installation shall comply with the requirements of the following Codes, Regulations and Standards.
  1. NFPA-30: Flammable and Combustible Liquids Code.
  2. STI F921: Standard for Above Ground Tanks with Integral Secondary Containment.
  3. API Standard 620: Welded Steel Tanks for Oil Storage.
  4. Florida Administrative Code Department of Environmental Protection (DEP) 62-761.
  5. PEI/RP200-96: Recommended Practices for Installation of Above Ground Storage Systems for Motor Vehicle Fueling.
  6. NFPA 30: Fuel Pipe Testing

#### PART 2 - PRODUCTS

##### 2.01 PIPE AND PIPE FITTINGS

- A. Fuel oil piping above grade shall be ASTM A53, grade B, seamless, black steel. Piping 2" and smaller shall be schedule 80. Piping 2-1/2" and larger shall be schedule 40. Piping shall be painted red

- B. Pipe fittings on steel pipe 2 shall be butt welded carbon steel conforming to ASTM A234, grade B and ANSI B16.9 of the same wall thickness as the pipe.
- C. Pipe fittings and unions on steel pipe 2" and smaller shall be forged steel, socket welded or screwed, 2000 W.O.G., conforming to ASTM A105, grade II.

## 2.02 FUEL OIL STORAGE TANK ACCESSORIES

- A. The controller shall be microprocessor-based, and shall be designed and constructed with modular architecture easily permitting either factory or field upgrades and servicing. Configuration and set-up data shall be maintained in non-volatile memory having minimum fifty (50) year data retention without requiring power of any kind. Replacement or substitution of any controller plug-in card shall not require system re-configuration. Real-Time clock and non-critical log data, such as inventory, delivery, alarm, theft, error, and leak reports shall be maintained in battery backed non-volatile memory with a minimum data retention of from (5)-(10) years in the event of a power outage. System shall include digital display for viewing tank information and LED indicators for the alarm conditions System shall have the capability to continuously monitor up to two (2) dual-float magneto stricture in-tank level probes and up to eight (8) secondary containment leak or point-level sensors. Leak and point-level sensor inputs shall support a means to detect sensor open-circuit and short-circuit wiring faults as a standard feature when used in conjunction with fault-reporting sensors. The system shall provide hardcopy 24 column environmental compliance reports, which exit the front panel or are stored internally with optional auto-winder take-up spool. The RS-232 serial port shall be standard for communications with a local PC computer. 12-channel Analog Output card shall be available to provide 0-20ma/4-20ma/0-24ma/0-1ma signals for tank-related real-time data. System shall operate on switch selectable 115/230 VAC (+/- 10%), 50/60 Hz. Maximum power consumption shall be 20 watts.
- B. Console: The console shall be housed in a lockable wall mounted in NEMA 4X outdoor configurations. A printer with auto-winder shall be available for the outdoor versions. The console shall include microprocessor board, probe/sensor card, power supply, control I/O and communications interfaces. Front panel display shall include audible and visual alarms, user-friendly membrane pushbutton controls, and optional impact printer. The display shall be nine digit, seven segment, quasi-alphanumeric sunlight readable LED type, with LED alarm annunciators for five (5) alarm conditions; leak, three (3) tank product setpoints, and one (1) bottom water setpoint per tank. LED alarm lights shall be visible from at least 60 feet and the seven-segment display data shall be readable from no less than twenty (20) feet. Displays shall include product gross or net, percent of capacity, 90/95/100% ullage, product and water level, product temperature, and product type. As a standard, two (2) programmable relay outputs and two (2) contact closure inputs shall be provided. All relays and contact closure inputs shall be user-programmable for activation by the following event types; Theft, Power Fail Recovery, System Error, Tank Leak, Product Setpoints, Water Setpoints, Leak/Point Level Sensors, Contact Closure inputs and Line Leak. The system shall be supplied with three industrial quality front panel sealed membrane pushbuttons labeled MODE, TANK SELECT, and

TEST. Membrane pushbuttons shall be utilized in conjunction with the display screen to select tank quantities, view, set, acknowledge alarm conditions; set/review configuration data, initiate system tests, view inventory and other logged data. The system shall provide hardcopy environmental compliance and status reports via front panel 24-column printer or with optional auto-winder take-up spool. The RS-232 serial port shall be provided as standard for two-way communications with a PC computer. Microsoft Windows 95 thru XP compatible software shall be provided to retrieve and display current tank statuses, remotely read, write and initialize system setup, clock, and configuration data. An RS-485 port shall be provided as standard for connection to "smart" peripherals, such as remote "slave" display and annunciator panels. The system shall be independently third party certified for UST petroleum storage tanks and have the capability to automatically or manually conduct a static volumetric tank tightness test to an accuracy of 0.2 GPH for monthly monitoring and 0.1 GPH for annual precision testing, with minimum test times of two hours and eight hours respectively. System shall be capable of performing both tests with as little as 20% of tank capacity.

- C. **Tank Gauging Probe:** Probe shall be designed for both AST and UST applications and shall have performance characteristics permitting 0.1 GPH or better in-tank leak test with continuous gauging accuracy of +/- 0.0005 inches for product, +/- 0.001 for water and +/- 0.001 degrees F for (relative) temperature. Probe shall contain an array of at least five (5) temperature sensors along its length for accurate volumetric temperature compensation. Probe to console communication shall employ digital transmission techniques carried over standard, readily available two-conductor, shielded cable, with a maximum cable length restriction of no less than 4000 feet. Probe operating temperature and pressure shall be -40 to +175 degrees F and 150 PSIG respectively. Probes shall be supplied with product float, water float, six (6) foot leader cable with watertight connector, and centering rings for riser mounted applications. Probe shall be UL/CSA approved for use in Class I, Division I, Group C & D hazardous locations.
- D. **Secondary Containment Leak Sensors:** Both non-discriminating and product/water discriminating leak sensors shall be available for liquid detection in interstitial spaces, containment areas, sumps, brine reservoirs, dispenser pans and piping locations. All sensors shall be optionally available with a wiring fault detection feature.
- E. Provide packaged leak detection system to monitor the interstitial space of the aboveground storage tank. Provide NEMA 4X leak detection local alarm panel and fuel piping monitoring wells, which monitors the sensor in the tank. Panel shall send leak detection alarm to the SCADA system. The panel shall operate on 120 VAC. Leak detection system shall be a complete system including the alarm panel, intrinsically safe sensor, jumper cables, integral disconnect switches, 2 dry contacts for communication with the SCADA system, relays, control power transformers, conduit, wiring, and built-in test diagnostics. Leak detection system shall be equal to Pneumercator systems.
- F. Provide an electronic tank gauging system. The system shall include a direct lift magnetic float, a liquid level tank mounted transmitter and a remote mounted electric

indicator panel with high and low level warning lights, audible alarm with silence button and two dry relay contacts for external controls. The indicating dial scale shall be capable of indicating in gallons and shall have the capacity to indicate 8,000 gallons. The electric indicator shall be motor driven with a built-in simulator for testing and calibrating the system. The system shall operate on 120 VAC and be equal to Pneumercator systems.

G. Tank monitoring system shall be Pneumercator TMS 2000

### 2.03 FUEL OIL SYSTEM APPURTENANCES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are as follows:

1. Special Duty Valves:
  - a. Automatic Switch Company (ASCO)
2. Vertical Ball Check Valve:
  - a. Lunkenheimer
3. Strainers:
  - a. Armstrong Machine Works
  - b. Hoffman Specialty ITT
  - c. Metraflex Company
  - d. Spriax Sarco
  - e. Watts Regulator Company
4. Oil Piping Specialties:
  - a. Morrison Bros. Co.

### 2.04 MONITORING WELL

A. Provide monitoring manhole, 12-inch diameter with 18-inch long skirt designed for sandy soil conditions constructed from cast iron top and steel skirt. Provide locking cover marked observation well. Monitoring well shall be equal to: OPW 104-GWO-1012.

## **PART 3 - EXECUTION**

### 3.01 PIPING INSTALLATION

- A. Remove all scale and dirt from pipe, both outside and inside, before installation.
- B. Ream the ends of all pipe to remove the burrs.
- C. Anchor and guide all piping in order to keep it from moving.
- D. Provide swing joints in supply and return piping at connections to tanks.
- E. Where pipes of different metals connect, ferrous to nonferrous, a dielectric or cast brass union shall be installed.
- F. Install flexible connectors at inlet and discharge connections to vibration producing equipment.



### 3.02 WELDED CONNECTIONS

- A. All joints in piping systems specified or noted to be welded shall be fusion welded, using standard catalogue product welding fittings. All welders must be certified.
- B. All pipe ends shall be beveled at 45 degrees to within 1/16 inch of inside wall. Abutting edges shall be sufficiently separated to provide for expansion. All welds shall be continuous around pipe and shall be made of sound metal, thoroughly fused into the ends of the pipe to the bottom of the "V", and built up in excess of the pipe wall. Fillet welds shall be built up to a depth of 1-1/4 times the wall thickness.

### 3.03 VALVE APPLICATIONS

- A. General Duty Valve Applications:  
Where specific valve types are not indicated, the following requirements apply:
  - 1. Shut-off duty: Use ball valves.

### 3.04 VALVE INSTALLATIONS

- A. Install valves in accessible locations that are protected from physical damage.
- B. Install shut-off duty valves at each branch connection to supply mains and elsewhere as indicated.
- C. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

### 3.05 FIELD QUALITY CONTROL

- A. Test oil piping in accordance with the requirements of NFPA 30 and fuel piping shall meet FDEP regulations 62-762. The piping shall be on the FDEP approved equipment list, as applicable.
- B. Remake leaking joints and connections using new materials.

### 3.06 COMMISSIONING

- A. Test and adjust controls and safety systems. Replace damaged or malfunctioning controls and equipment.
- B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
- C. Review data in Operating and Maintenance Manuals. Refer to Division 1 section "Project Closeout".
- D. Before activating system perform these steps:
  - 1. Open valves to full open position. Close bypass valves.
  - 2. Remove and clean strainer screens.
  - 3. Fill storage tank with proper fuel type.
  - 4. Check operating controls of fuel burner units.

END OF SECTION

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