

**SECTION D**

**SHELBY COUNTY GOVERNMENT**

**ENGINEERING SECTION**

**PLANS  
&  
SPECIFICATIONS**

## SECTION 01150

### MEASUREMENT AND BASIS OF PAYMENT

#### PART 1 - GENERAL

##### 1.01 ITEMS INCLUDED

- A. Those items included in the proposal which have been installed in accordance with the Plans and Specifications and which have been approved by the Engineer shall be measured and paid for in the manner presented hereinafter. Payment shall be compensation in full for furnishing all materials and equipment and performing all labor and services necessary for constructing complete all of the work, ready for operation as shown on the Plans and as specified herein. Any work specified but not included in the Proposal shall be considered incidental and shall not be a separate pay item.

##### 1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract
- B. The Bid Form
- C. Section 01152: Applications for Payment
- D. Section 01700: Contract Closeout

#### PART 2 - BID FORM

##### 2.01 BID FORM

- A. All pay line items will be paid for at the prices named in the Bid Sheets for the respective items of work.
- B. Quantity variations in excess of the allowable quantity changes specified herein shall be subject to the provisions of Article 10 of the General Conditions.

##### 2.02 MOBILIZATION (Bid Item No. 1)

- A. Measurement for payment for Mobilization will be based upon completion of such work as a lump sum, non-proratable pay item, and shall require completion of all of the listed items during the first 25 days following Notice to Proceed.
- B. Payment for Mobilization will be made at the lump sum allowance named in the Bid Form under Item No. 1, which price shall constitute full compensation for all such work. Payment for mobilization will be made in the form of a single, lump-sum, non-proratable payment, no part of which will be approved

for payment under the Contract until all mobilization items listed herein have been completed as specified. Additionally, payment for this Bid Item No. 1 shall not exceed ten percent (10%) of the sum of Bid Item Nos. 2 through 5 inclusive. The scope of the work included under Pay Item No. 1 shall include, but not be limited to the following principal items: the obtaining of all bonds, insurance and permits; moving onto site of all necessary equipment; all temporary construction facilities as required for the proper performance and completion of the Work, submittal of estimated progress schedule per Section 01310, major equipment submittals not requiring Pre-Bid approval and provision of temporary utilities if necessary.

#### 2.03 SEWER FILTER SYSTEM & RECIRCULATION TANK (Bid Item No. 2)

- A. Measurement for payment for the Sewer Filter System & Recirculation Tank will be based upon the complete installation of a new and operating sewer filter system and recirculation tank complete with all connections installed, as specified and shown on the drawings.
- B. Payment for the installation of the Sewer Filter System & Recirculation Tank will be made at the lump sum price named in the Bid Form under Item No. 2, which price shall constitute full compensation for the provision and installation of a new sewer filter system, recirculation tank with appurtenances including, but not limited to, pumps, internal piping, connections to piping, fittings, vents, gravel base, testing of all components, on-site training of Owner's staff by major equipment vendors and all other appurtenant work as required to complete the work as specified and shown in the drawings.

#### 2.04 YARD PIPING (Bid Item No. 3)

- A. Measurement for payment for Yard Piping will be based upon the complete installation of all new piping and fittings as a lump sum item, as specified and shown on the drawings.
- B. Payment for Yard Piping will be made at the lump sum price named in the Bid Form under Item No. 3, which price shall constitute full compensation for the provision and installation of all new fittings, piping, earthwork, connections to existing piping, testing of all components, on-site training of Owner's staff by major equipment vendors and all other appurtenant work as required to complete the work as specified and shown in the drawings.

#### 2.04 ELECTRICAL & CONTROLS WORK (Bid Item No. 4)

- A. Measurement for payment for the Electrical & Control Work will be based upon completion of the entire working electrical and control system as a lump sum

item, complete, in accordance with the specifications and as shown on the drawings.

- B. Payment for such Electrical & Control Work will be made at the lump sum price named in the Bid Form under Item No. 4, which price shall constitute full compensation for said electrical and control work including, but not limited to, the furnishing and installation of all electrical conduit, wiring, switches, boxes, pull boxes, connection of power and control wiring, disconnects, level controls, indoor installation of the panel, telemetry equipment and other devices as required to make fully functional the electrical and control operation of the Work. Additionally, this item shall include the on-site training of Owner's staff in the operation and maintenance of all electrical and control devices as specified and as shown in the drawings.

## 2.05 SITE WORK & RESTORATION (Bid Item No. 5)

- A. Measurement for payment for Site Work & Restoration will be made upon completion of all site-related work as a lump sum item, complete in accordance with the specifications and as shown in the drawings.
- B. Payment for Site Work & Restoration will be made at the lump sum price named in the Bid Form under Item No. 5, which price shall constitute full compensation for site work and restoration including fences, final fine grading of all disturbed areas, distribution and compaction of excavated soil on-site as directed by the Engineer, placement of top soil, seeding, mulching, watering, fertilizing and establishment of a full vegetative cover of grass on all disturbed areas, site cleanup, lawful and permitted disposal of excess soil (permits, if necessary and at contractor's expense), and all other necessary work required to complete said work in accordance with the specifications and as shown in the drawings.

**END OF SECTION**

## SECTION 02221

### TRENCHING, BACKFILLING, AND COMPACTION

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Excavation for piped utility material.
- B. Provide necessary sheeting, shoring and bracing.
- C. Prepare trench bottom with appropriate materials.
- D. Dewater excavation as required.
- E. Place and compact granular beds, as required, and backfill.

##### 1.02 RELATED WORK

- A. Section 01800: Preparatory and Restoration Work
- B. Section 02722: Sanitary Sewage Systems

##### 1.03 PRECAUTIONS

- A. Notify utility companies when necessary to disturb existing facilities and abide by their requirements for repairing and replacing.
- B. Protect all vegetation and other features to remain.
- C. Protect all benchmarks and survey points.

#### PART 2 - PRODUCTS

##### 2.01 BEDDING AND BACKFILL MATERIALS

- A. Class I Material: Angular, 1/4 to 1 inch graded stone including a number of fill materials that have regional significance such as crushed stone, cinders, slag, and crushed shells.
- B. Class II Material: Coarse sands and gravels with a maximum particle dimension of 1-1/2 inch including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.

- C. Class III Material: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures.
- D. Class IV Material: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.
- E. Class V Material: Organic soils, as well as, soil containing frozen earth, debris, rocks larger than 1-1/2 inches and other foreign material. Whenever encountered in the trench Class V Material shall be removed and disposed of as excess excavation. Class V Material shall not be used for pipe bedding or backfill.
- F. Class A Material: Continuous concrete cradle constructed in conformity with details shown on drawings, consisting of Class "B" concrete, 3000 psi minimum comprehensive strength at 28 days.
- G. Class B Material: Sand or a natural sandy soil, all passing a 3/8" sieve with not more than 10% passing a No. 200 sieve; or stone, gravel, chert or slag.
- H. Class C Material: Natural ground or compacted embankment at a depth of at least 10% of the outside vertical pipe diameter.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Install barriers and other devices to protect areas adjacent to construction.
- B. Protect and maintain all benchmarks and other survey points.

#### **3.02 EXCAVATION TRENCHES**

- A. Perform in such a manner as to form a suitable trench in which to place the pipe and so as to cause the least inconvenience to the public.
- B. Maximum width at the crown of the pipe - 2'-0" plus the nominal outside diameter of the pipe.
- C. Cut pavement along neat, straight lines with pavement saw.
- D. Trench depth: As shown on the plans.

- E. Align trench as shown on the plans unless a change is necessary to miss an unforeseen obstruction. If an unforeseen obstruction is encountered, do not proceed without the direction of the Owner's Representative.
- F. For pressure lines, shape the bottom of the trench to provide uniform bearing of the pipe on undisturbed earth throughout its entire length. Dig bell holes to aid in securing uniform support of the pipe.
- G. For gravity lines, fill the bottom of the trench with granular material as specified herein as shown on the Plans.
- H. When unstable soil is encountered at the trench bottom, remove it to a depth required to assure support of the pipeline or to a depth directed by Owner or Owner's designated representative and backfill to the proper grade with Class I material.
- I. Unless otherwise directed by Owner or Owner's designated representative, all areas requiring undercut shall be underlain by a heavy weight, non-woven geotextile filter fabric sufficient to encapsulate all bedding material as shown on the plans.
- J. No more than 50 feet of trench will be excavated ahead of backfilling operations unless otherwise permitted by the Owner, or Owner's designated representative.

### 3.03 SHEETING SHORING, AND BRACING

- A. When necessary or when required by local, State or Federal safety requirements, furnish, put in place, and maintain such sheeting, bracing, etc., as may be required to support the sides of the excavation and to prevent movement which can in any way damage adjacent pavement or other structures, damage or delay the work or construction or endanger life or health.
- B. Take care to prevent voids outside the sheeting.
- C. If voids are formed, immediately fill and ram to the satisfaction of the Owner's Representative.
- D. Devise plans for performing this work subject to the approval of the Owner's Representative.
- E. Unless adjacent facilities will be injured, remove all sheeting, shoring and bracing after backfill has been placed to within 18 inches of the final surface grade.

- F. If adjacent facilities will be injured by the removal of sheeting, cut shoring off at the top of the pipe and leave the lower section in the trench.

### 3.04 DISPOSAL OF EXCAVATED MATERIAL

- A. Satisfactorily dispose of all excess excavated material that cannot be used or is not suitable for trench backfill.

### 3.05 UNAUTHORIZED EXCAVATION

- A. All excavation outside or below the proposed lines and grades shown on the plans.
- B. Backfill areas of unauthorized excavation with the type material necessary (earth, rock or concrete) to insure the stability of the utility or structure involved.
- C. Unauthorized excavation or backfill to replace same shall be at Contractor's expense.

### 3.06 REMOVAL OF WATER

- A. Keep excavated areas free of water while work is in progress.
- B. Dewatering shall be performed as required by ground conditions at no additional cost to the Owner.
- C. Take particular precautions to prevent the displacement of structures or pipelines as a result of accumulated water.

### 3.07 OBSTRUCTIONS

- A. Obstructions shown on the plans are for information only and do not guarantee their exact locations nor that other obstructions are not present.
- B. When utilities or obstructions are not shown on the plans but are present at the location of a proposed utility route, the Contractor may request to relocate the pipeline if necessary to avoid disturbing the utility or obstructions.
- C. Exercise due care in excavating adjacent to existing obstructions and do not disturb same.
- D. In the event obstructions are disturbed, repair or replace as quickly as possible to the condition existing prior to their disturbance.

- E. If required by the Conditions of the Contract, pay for the repair or replacement work performed by the forces of the utility company or other appropriate party.
- F. If replacement or repair of disturbed obstructions is not performed after a reasonable period of time, the Owner may have the necessary work done and deduct the cost of same from payments to the Contractor.

### 3.08 BEDDING FOR PRESSURE LINES

- A. Unless shown otherwise on the plans:
  - 1. Bed in a trench cut in natural ground.
  - 2. Dig bell holes to assure uniform support throughout the entire length of pipe.
  - 3. Excavate the trench in such a manner as to form a suitable bed in which to place the pipe.

### 3.09 INITIAL BACKFILLING

- A. Do not begin backfilling before the Owner, or Owner's designated representative has inspected the grade and alignment of the pipe, the bedding of the pipe, and the joints between the pipe. If backfill material is placed over the pipe before an inspection is made, reopen the trench in order for an inspection to be made.
- B. The initial backfill shall be mechanically tamped in lifts not exceeding eight inches loose to a minimum of 90% Standard Proctor density, ASTM D698, to a point 18" above the top of the pipe. Compaction testing shall be conducted along the completed initial backfill at 50' maximum intervals, or more frequently as conditions may warrant.

### 3.10 FINAL BACKFILLING

- A. After the backfill has reached a point 18" or more above the top of the pipe, perform final backfilling depending on the location of the work and danger from subsequent settlement.
- B. Backfilling in Unimproved Areas:
  - 1. Dispose of and replace all soft or yielding material which is unsuitable for trench backfill with suitable material.

2. Deposit backfill to the surface of the ground by dragline, bulldozer, or other suitable equipment in such a manner so as not to disturb the pipe.
  3. Backfill shall be compacted to at least 90% Standard Proctor density, ASTM D698. Backfilling shall be performed in lifts not exceeding eighteen inches, loose. Compaction testing shall be conducted along every third lift at 50' maximum intervals, or more frequently as conditions may warrant.
  4. Neatly round sufficient surplus excavated material over the trench to compensate for after settlement.
  5. Dispose of all surplus excavated material.
  6. Prior to final acceptance, remove all mounds to the elevation of the surrounding terrain.
  7. Contractor shall maintain backfilled trench until warranty period of project is expired.
- C. Backfilling Beneath Driveways and Streets where Rigid and Non-Rigid Type Surfacing is to be replaced:
1. Use Class I granular material meeting gradation requirements of CR-610.
  2. Carefully deposit in uniform layers, not to exceed 12" thick.
  3. Compact each layer with tools suitable for that purpose in such a manner so as to not disturb the pipe.
  4. Backfill shall be compacted to a minimum Relative Density of 70%, ASTM D4253 and D4254.
  5. See Section 01800 for final surface replacement specifications.
- D. Backfilling of Shoulders along Streets and Highways:
1. Backfilling methods and materials for shoulders along streets and highways shall be in accordance with the requirements of governing local, county, or state departments maintaining the particular roadway or highway.
  2. Replace with similar materials, all shoulders which may be damaged or destroyed as a result of pipe trenching.

3. Backfill shall be compacted to at least 95% Standard Proctor, ASTM D 698. Fill shall be placed in loose lifts not exceeding 9". Compaction testing shall be conducted along each lift at 50' maximum intervals, or more frequently as conditions may warrant.
- E. Crushed Stone for Pavement Maintenance and Shoulder Replacement:
1. Where possible, salvage and reuse all base material that is removed during construction.
  2. Wet and thoroughly compact crushed stone and blade to tie into the existing surface prior to final acceptance.
- F. Backfilling Under Proposed Areas to be Paved:
1. Carefully deposit in-situ excavated material in loose lifts not exceeding 12".
  2. Compact each lift to at least 95% Standard Proctor, ASTM D698.
  3. Compaction testing shall be required for every second lift at 50' maximum intervals, or more frequently, as conditions may warrant.

**END OF SECTION**

## SECTION 02722

### SEWERAGE SYSTEMS

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Installation, testing and sewer line force mains and appurtenances.

#### PART 2 - PRODUCTS

##### 2.01 POLYVINYL CHLORIDE PIPE (PVC)

- A. Provide PVC pipe meeting the following standards:
  - 1. Pressure Rating 250 psi, SDR 17 PVC Pipe (2" to 4" Diameter)
    - a. Shall meet the requirements of ASTM Standard D-2241.
    - b. Manufactured from products equal in quality to products made from class 12454 virgin compounds as defined by ASTM D1784. All compounds shall qualify for a rating of 4,000 psi for water at 73.4 degrees F per requirements of PPI TR3.
    - c. The PVC compounds used to make pipe shall contain no ingredient in an amount that has been demonstrated to migrate into water in quantities considered toxic.
    - d. PVC compounds or products shall be tested for chemical extractants and certified as suitable for use for potable-water distribution service and meeting the requirements of NSF Standard #14, Section 3 and 4; and Standard #61.
    - e. All PVC pipe shall be color keyed for potable water service, blue.
- B. Joints for pipe shall meet the following:
  - 1. Push-on gasketed joints shall be in accordance with ASTM D3139.
  - 2. The joint gasket shall conform to the requirements of ASTM F477.

##### 2.02 FLOW METER

- A. Provide inline flow meter meeting the following standards:
  - 1. Electromagnetic flow meter, 2" diameter with remote amplifier
    - a. Minimum of plus / minus 0.25% accuracy
    - b. Detector flow range of 0.1 to 39.4 feet per second.

- c. Pipe spool material shall be 316 stainless steel.
- d. Contractor will provide unit with PVC pipe adapters for connection to meter's flanged ends, 30 feet of cable, and grounding ring.
- e. Wall mounted remote amplifier capable of recording flow.
- f. Unit shall be Badger Mag Meter model M2000 with remote amplifier, or approved equal.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Prior to laying pipe, prepare a suitable bedding according to Section 02221.
- B. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.
- C. Swab the interior of the pipe to remove all undesirable material.
- D. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

### **3.02 INSTALLING SANITARY SEWERS**

- A. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.
  - 1. Where laser equipment is used, provide offset hubs at every 50 foot station for purposes of checking grade between sections.
  - 2. Where batter boards are used, furnish stakes at intervals of 50 feet along the route of the pipeline.
  - 3. Set stakes at such distance from centerline of excavation as is suitable for the excavating method and machinery used.
  - 4. Provide and use accurately set batter boards at each 50 foot interval in establishing the bottom invert of each pipe laid.
- B. Accurately establish the centerline of each pipe using a string stretched between targets and a plumb line extended to the centerline of the pipe.
- C. Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject and remove any defective pipe or fitting from the job site.
- D. Lay pipe progressively up grade, with bell upstream, in such manner as to form close, concentric joints with smooth bottom inverts. Joining of all pipe shall be in accordance with manufacturer's specifications.

- E. Bed each pipe section in accordance with Section 02221.
- F. Do not allow walking on completed pipelines until backfill has been placed to a depth of at least 6 inches above the crown of the pipe.
- G. Keep the interior of the pipe free of all unneeded material.
- H. When laying pipe ceases, close the open ends of the pipe with a suitable plug for preventing the entrance of foreign materials.

### 3.03 INITIAL PROOF TESTING OF SANITARY SEWERS

- A. It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance.
- B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, cleanliness, and leakage.
- C. In the event that four or more reaches fail to satisfactorily pass proof testing procedures, cease pipe laying until deficiencies are identified and corrected.
- D. The basis for grade, alignment and cleanliness testing will be a visual inspection. Leakage testing will be by means of low pressure air or exfiltration or infiltration as deemed by the Engineer.

### 3.04 PRESSURE TESTING OF PRESSURE SEWERS MAINS

- A. After the pipe has been laid, subject all newly laid pipe or any valved section thereof to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing.
- B. Test pressures shall:
  - 1. Not be less than 1.25 times the working pressure at the highest point along the test section.
  - 2. Not exceed the pipe or thrust restraint design pressures.
  - 3. Be of at least 2-hour duration.
  - 4. Not vary by more than  $\pm 5$  psi.
  - 5. Not exceed twice the rated pressure of closed valved or hydrants included in the test section.
  - 6. Not exceed the rated pressure of resilient-seated butterfly valves.
  - 7. Be at least 150 psi.
- C. Pressurization
  - 1. Slowly fill each valved section of pipe with water.
  - 2. Apply the specified test pressure, based on the elevation of the lowest point of the line or section under test and correct to the elevation of the test gauge by means of a pump connected to the pipe in a manner satisfactory to the Owner.

D. Air Removal

1. Before applying the specified test pressure, expel air completely from the pipe, valves, and accessories.
2. If permanent air vents are not located at all high points, install corporation cocks at such points to expel air as the line is filled with water.
3. After all the air has been expelled, close the corporation cocks and apply the test pressure.
4. At the conclusion of the pressure test, remove the corporation cocks and plug or leave in place at the discretion of the Owner.

E. Examination

1. Carefully examine all exposed pipe, fittings, valves, and joints.
2. Repair or replace any damaged or defective pipe, fittings, or valves that are discovered with sound material and repeat the test until it is satisfactory to the Owner.

3.05 TIE-INS

- A. Existing lines shall remain in place and in working order until the exact planned time of tie-ins is required.
- B. Should existing lines become damaged during construction at any time prior to time of tie-in, the Contractor shall assume full responsibility for repairing and returning to normal operation.
- C. Tie-ins shall be made in full coordination with the Owner.

3.06 FLOW METER INSTALLATION

- A. Flow meter shall be installed in-line in the existing meter box at the site. Contractor will be responsible for all bracing and connections to the existing pipe, including fittings and adapters as necessary to install the meter.
- B. Contractor shall provide and install conduit, fittings, hardware, brackets, wiring, electrical connections, breakers, and other necessary appurtenances to completely install the meter and the remote amplifier. Amplifier shall be installed in the control house on the wall.
- C. Contractor will provide training to County maintenance staff on the programming and use of the meter and amplifier.

**END OF SECTION**

## SECTION 11390

### PACKAGE FILTER SYSTEM SPECIFICATIONS

#### PART 1 – GENERAL

##### 1.01 DEFINITIONS

Wherever used in these specifications and printed with initial bold capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof.

1. *Bid* – The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the work to be performed.
2. *Bidder* – The individual or entity who submits a Bid directly to the Owner.
3. *Contractor* – The individual or entity with whom Owner has entered into the agreement.
4. *Engineer* – The individual or entity named as such in the agreement.
5. *Inspector* - The specific individual designated by the Owner, Engineer, Contractor, and Manufacture to ensure quality control by inspecting and certifying that the installation of the AdvanTex® treatment system is in compliance with the Manufactures recommendations and requirements.
6. *Manufacture* – A supplier, fabricator, distributor, material man, or vendor having a direct contract with Contractor or Owner to furnish materials or equipment to be incorporated in the work by contractor.
7. *Owner* – The individual or entity with whom Contractor has entered into the agreement and for whom the work is to be performed.
8. *Operator* – The individual or entity with whom the owner has entered into an agreement and for whom operation and maintenance shall be performed.

##### 1.02 GENERAL DESCRIPTION

The **MANUFACTURER** shall furnish a complete advanced treatment package(s), consisting of a pump vault, effluent screen, discharge assembly, ball valve, check valve, splice box, treatment system, recirculating splitter valve, and controls.

##### 1.03 SUBMITTALS

The **MANUFACTURER** shall furnish six (6) sets of shop drawings and technical data sheets. The submittals shall clearly specify the materials of construction, equipment compatibility, along with drawings for each unique package being supplied.

##### 1.04 OR-EQUAL EVALUATIONS

- A. Throughout the equipment specifications you will find the term “or approved equal.” For this project, this term “approved equal” shall mean equal in the

judgment of the **ENGINEER**. Should the **CONTRACTOR** seek approval of a product other than the brand or brands named in the specifications, it shall furnish written evidence that such product conforms in all respects to the specified requirements, and that it has been used successfully elsewhere under similar conditions. It will not be the responsibility of the **MANUFACTURE** specified within these specifications to provide research, documentation, or data supporting the difference between the "or equal" and the specified product. This will be the sole responsibility of the **CONTRACTOR** seeking the approval.

- B. Where the specified requirements involve conformance to recognized codes or standards, the **BIDDER** shall furnish evidence of such conformance in the form of test or inspection reports, prepared by a recognized agency, and bearing an authorized signature. Manufacturer's standard data and catalog cut sheets will not be considered sufficient in themselves, and the engineer will not be responsible for seeking further data from the manufacturer, or for otherwise researching the product. Failure to provide complete data will be cause for rejection of the product. The submission shall include any impacts that could be expected from the alternative product and shall also indicate any product that would require a license or royalty, the actual fees, and a note that these fees would be handled by the **BIDDER**. The **BIDDER** shall provide submissions; meeting the above parameters no less than TWO WEEKS prior to **BID** opening for review by the **ENGINEER**. **CONTRACTORS** seeking approval of "or equal" products or systems shall provide, at minimum, the following.
- C. Product/System submittals, including, but not limited to;
1. The number of years the **MANUFACTURER** has been in business of manufacturing relevant products/systems
    - a. Size of company, including
      - 1) Number of employees related to relevant products/systems
      - 2) Number of engineers on staff related to relevant products/systems
    - b. Product specifications and a detailed description of how each product or component is "equal" to the specified product, system, or component. A side by side comparison is required.
      - 1) Equipment/system warranty along with exclusions
      - 2) Performance claims, including, but not limited to;
        - a) Treatment design
          - Surface area
          - Maintenance frequency
        - b) Pump motor description

- Manufacturer and origin
  - Length of service
  - Number of units in operation
  - Life-cycle cost (repair and replacement frequency)
  - Warranty
- c) Pump liquid end description
- Manufacturer and origin
  - Length of service
  - Number of units in operation
  - Life-cycle cost (repair and replacement frequency and cost). Note liquid ends must be remove-able and repairable and cleanable.
  - Warranty
- d) Corrosion resistance
- e) Pump Lead description
- Lead must be SOOW, extra heavy duty cord (600V) CSA approved.
- f) Control panel components
- Manufacturer and origin
  - Length of service
  - Number of units in operation
  - Warranty
  - Enclosure description
- c. Evidence of successfully obtaining approval for a system with similar permit requirements with the regulating authority
- d. Summary of product/system track record and history, including, but not limited to;
- 1) Number of similarly sized systems
  - 2) Detailed summary of, at minimum, ten (10) similarly sized systems, at least five (5) years old, including, but not limited to;
    - Project name, location, and application
    - Years in operation
    - Current average daily flows and design flows

- Operator name and contact information
2. **BIDDER** shall specify and furnish documentation related to manufacturer (or representative) support services, including, but not limited to;
    - a. Installation training program and support material
    - b. Installation oversight program and support material
    - c. Operator training program and support material
    - d. Startup services program and support material

**1.05 EXPERIENCE CLAUSE**

The equipment furnished shall be manufactured and supplied by a company experienced in the design and manufacture of advanced treatment systems. **MANUFACTURERS** shall have a minimum ten (10) years' experience in the design and manufacture of advanced treatment systems of similar size and equipment specified. **MANUFACTURERS** shall have at minimum of twenty-five (25) successful installations of advanced treatment systems.

**1.06 WARRANTY BOND**

The **MANUFACTURER** shall, upon request, furnish a two-year warranty bond. The warranty bond will guarantee the performance of the equipment in the event that it fails within the bond period.

**1.07 MANUFACTURER**

The **MANUFACTURER** shall be Orenco Systems®, Inc. or approved equal. The **MANUFACTURER** shall furnish a complete factory built advanced treatment system, each consisting of a pump vault, effluent screen, discharge assembly, ball valve, check valve, splice box, treatment system, recirculating splitter valve, and controls. The **MANUFACTURER** shall supply detailed installation and O&M instructions. The **MANUFACTURER** shall also provide the following support personnel:

- Professional engineer or personnel under the direct supervision of a professional engineer dedicated to supporting the project through design, construction, and O&M.
- Asset Management Department dedicated to assisting operators with operational and maintenance activities.

**1.08 WARRANTY**

The advanced treatment system **MANUFACTURER** shall provide a three (3) year warranty for the entire treatment system, including, but not limited to the pump, pump vault, hose and valve assembly, control panel, and splice box. Warranty term shall ensue after **OWNER'S** acceptance and system startup procedures are complete. The **MANUFACTURER** shall submit detailed exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition. The warranty shall be documented in product literature.

**1.09 SERVICABILITY**

The advanced treatment system components shall be completely serviceable,

with easy access to the pump(s), effluent screen, treatment system, and floats. The pump shall be designed for removal without removing the effluent screen and floats.

#### 1.10 PUMPS

The pump must be approved for use in pump vault as described in these specifications. Pump shall be 3/4 to 1.0 hp, 230 VAC, single phase, 60 Hz, two-wire motor, with 10 foot long extra heavy duty (SOOW) electrical cord with ground. The pumps must be submersible High-Head Effluent pumps. Pumps shall be UL and CSA listed for use with effluent. The pumps must have a minimum 24-hour run dry capability without water lubrication. The pumps shall have a 1/8-inch bypass orifice to ensure flow circulation for motor cooling and to prevent air bind. The pump shall have a floating impeller design to protect against up thrust and increase pump life. The pumps liquid ends must be repairable (by replacing impellers and/or diffusers) for better long-term cost of ownership. The motor must be rated for continuous use and frequent cycling, at least 100 cycles per day. The motor cable must be suitable for Class 1, Division 1 and 2 applications. The pumps shall be lightweight for easy removal and maintenance. The pump intake screen must be 1/8-inch mesh polypropylene. The pump shall have internal thermal overload protection and internal lightning protection. All pumps shall undergo 3-point (Dead head, Design Flow, and Design Flow + 30%) wet testing at the factory to confirm performance.

#### 1.11 TANKS GENERAL

A. The **MANUFACTURER** shall provide the structural design and certification to the engineer for review. The design shall be in accordance with accepted engineering practice. Precast concrete or fiberglass tanks shall have been designed by a registered engineer and approved by state or local regulatory agencies or authorities.

B. Loading Criteria:

- a. There shall be 140 lbs./cu.ft. for minimum weight of saturated backfill, or 127 lbs./cu.ft. for unsaturated backfill (500 lbs./sq.ft.minimum).
- b. Minimum lateral loading shall be 62.4 lbs./cu.ft. Lateral loading shall be determined from ground surface.
- c. The tank shall also support a concentrated wheel load of 2500 lbs.

C. There are four (4) typical loading conditions that should be analyzed:

1. 4 ft. Bury + Full Exterior Hydrostatic Load
2. 4 ft. Bury + Full Exterior Hydrostatic Load + 2500 lb. Wheel Load.
3. 1 ft. Bury + 2500 lb. Wheel Load.
4. Tank Full, Interior Hydrostatic Load and Unsupported by Soil.

*Load Case 4 represents the tank full of liquid at 62.4 lbs/cu.ft. This condition*

*addresses seam and haunch stress-strain relationships that occur during watertightness testing, as well as poor soil bedding conditions that provide inadequate support.*

- D. Tanks requiring deep burial (>48") or subject to truck or heavy traffic loading require special consideration. (A minimum soil cover of 12" shall be used, unless specified otherwise by manufacturer.)
- E. All tanks shall be structurally sound and watertight and shall be guaranteed in writing by the tank **MANUFACTURER** for a period of two years from the date of final acceptance. **MANUFACTURER'S** signed guarantee shall accompany **BIDS**. The tank guarantee/warranty shall be furnished at the time of submittal. Tank warranty shall not be limited liability to replacement cost of the tanks. The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
- F. Tanks shall be manufactured and furnished with access openings 20" in diameter and of the configuration shown on the manufacturer's drawings. Modification of completed tanks will not be permitted.
- G. Inlet plumbing shall include an inlet tee that penetrates 18" into the liquid from the inlet flow line. (The depth may vary depending on the tank's height; in all cases, though, the inlet should extend to a level below the bottom of the maximum scum depth.) The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.
- H. Tanks shall be capable of successfully withstanding an aboveground static hydraulic test and shall be individually tested.
- I. All tanks shall be installed in strict accordance with the manufacturer's recommended installation instructions

#### **1.12 CONCRETE TANKS**

- A. Walls, bottom and top of reinforced concrete tanks shall be designed across the shortest dimension using one-way slab analysis. Stresses in each face of monolithically constructed tanks may be determined by analyzing the tank cross-section as a continuous fixed frame.
- B. The walls and bottom slab shall be poured monolithically; alternatively, water stops may be provided.
- C. Reinforcing steel shall be ASTM A-615 Grade 60,  $f_y = 60,000$  psi. Details and placement shall be in accordance with ACI 315 and ACI 318.
- D. Concrete shall be ready-mix with cement conforming to ASTM C150, Type II. It shall have a cement content of not less than six (6) sacks per cubic yard and maximum aggregate size of 3/4". Water/cement ratio shall be kept low ( $0.35 \pm$ ), and concrete shall achieve a minimum compressive strength of 4000 psi in 28 days. The Contractor shall submit a concrete mix design to the Engineer for review and approval. Three (3) concrete sample cylinders shall be taken and tested for each tank manufactured until the manufacturer and Engineer are satisfied that the minimum compression strength is being obtained. To ensure compliance, the manufacturer shall then make and set three (3) sample cylinders for a minimum of 20% of the remaining tanks at the

discretion of the Engineer. If the minimum compressive strength is not being obtained, the manufacturer shall be required to make and test sample cylinders for each tank manufactured. Calcium chloride will not be allowed in the mix design. The cost of testing cylinders shall be the tank manufacturer's responsibility. The tank manufacturer may supply a Swiss hammer for compressive testing in the field in lieu of sample cylinders.

- E. Tanks may be protected by applying a heavy cement-base waterproof coating, on both inside and outside surfaces, in compliance with Council of American Building Officials (CABO) report #NRB-168; 6181; however, the tank should be watertight without the addition of seal coatings.
- F. Form release used on tank molds shall be Nox Crete™ or approved equal. Diesel or other petroleum products are not acceptable.
- G. Tanks shall not be moved from the manufacturing site to the job site until the tank has cured for seven (7) days or has reached two-thirds of the design strength.
- H. Tanks shall be manufactured and furnished with access openings of the size and configuration to accommodate individual packaged pump systems. For 24" diameter access risers, the tank manufacturer shall cast in place a flanged tank adapter to facilitate the bonding of a 24" diameter access riser. The flanged tank adapter shall be made of 1/4" thick ABS and shall have an outside diameter of 27" and an inside diameter of 22-3/4". The flanged adapter shall be Orenco Systems®, Inc. Model PRTA24 or engineer-approved equal. The adapter must have an overall height of no less than 3" to allow 1-1/2" exposed for sufficient bonding area once the adapter is installed in the tank. For 21" and 30" diameter access risers, either a grooved tank adapter plate (Model RRFTA or RRFTA30) or a flanged tank adapter (Model PRTA30) may be installed in the tank. The adapter shall be manufactured of fiberglass or ABS and shall accommodate either a 21" or 30" diameter access riser.
- I. The septic tank and the top slab shall be sealed with a preformed flexible plastic gasket. The flexible plastic gasket shall be equal to the flexible butyl resin sealant congeal CS-102 or CS-202 as manufactured by Concrete Sealants, Inc. of New Carlisle, Ohio, and shall conform to federal specification SS-S-00210(2iOA) and AASHTO M-198. A mechanical fastening method shall be used if the seasonal groundwater level may reach the top slab seam of the tank.
- J. In order to demonstrate watertightness, tanks shall be tested at the factory and again on-site prior to acceptance. Inlets to the septic tank will be watertight pipe seal Cast-A-Seal™ (Manufactured by Press-Seal Gasket Corporation) or approved equal. Each tank shall be tested at the factory, prior to shipping, by filling with water to the soffit and letting stand. After 24 hours, the tank shall be refilled to the soffit and the exfiltration rate shall be determined by measuring the water loss during the next two (2) hours. Any leakage shall be cause for rejection. After installation is completed and before backfilling, each tank shall be filled with water to a point 2" above the

top of the tank and the water loss measured after a twenty four-hour period. After it has been determined that there is no leakage, test the access riser seam. Backfill to a minimum depth of 2" above the riser seam to prevent damage from hydrostatic uplift. Fill the tank to a point 2" above the riser seam (the field test period may be reduced to not less than two (2) hours). No tank will be accepted if there is any leakage over the two (2) hour period.

### 1.13 FIBERGLASS TANKS

A. The **MANUFACTURER** shall be Orenco Systems®, Inc. or approved equal. The **MANUFACTURER** shall supply detailed installation, O&M instructions, and warranty terms to the **ENGINEER**.

1. Method of Calculations:

- a. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
- b. Calculations shall address the following:
- c. strength
- d. buckling
- e. deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
- f. buoyancy

2. Performance testing

B. The material properties and laminates considered in this analysis shall be fiberglass reinforced polyester resin, using grades of resin and fiberglass considered acceptable for use with septic tank construction. The thicknesses for different regions of the tanks shall be described and shown in shop drawings for each individual tank.

Typical primary strength properties are listed below:

Tensile Modulus (psi)	1,000,000
Ultimate Tensile strength (psi)	10,000
Ultimate Compressive strength (psi)	21,000
Ultimate Flexural strength (psi)	18,000
Ultimate Shear In-Plane (psi)	7,000

- C. In lieu of calculations for fiberglass tanks, the supplier may elect in-situ performance testing.
- D. In-situ testing of each tank model shall include use of strain gauge and deflection gauge. The tank will be subjected to external forces equal to twice the actual load.
- E. Maximum initial deflection based on test loading shall not exceed 3% of the tank diameter.
- F. Performance testing will be evaluated by a Registered Professional Engineer (P.E.). The Engineer will have the sole responsibility to determine the

maximum external loading on any of the tank models.

- G. The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.
- H. Inspections may be made by the engineer in the supplier's yard, within the plant, upon delivery and again after installation. The minimum wall thickness shall be 3/16". If the wall thickness is suspected to be less than 3/16" or if delamination is suspected within any portion of the tank, the engineer may drill a 1/4" diameter hole through the tank wall for inspection purposes. If the required minimum 3/16" thickness is not found, repair if feasible shall be the responsibility of the contractor. If repair is judged not feasible, the tank shall be rejected. If twenty percent (20%) or more of the tanks are rejected for any of the aforementioned reasons, each tank under this BID will become suspect of substandard quality and subject to rejection by the engineer. If the required minimum 3/16" thickness is found and no delamination is present, the repair of the inspection holes shall be the responsibility of the engineer.
- I. The engineer shall specify the minimum weight of each tank model that will be allowed. The manufacturer will permanently mark the weight of each tank on the top near the access hole.
- J. The minimum tank weight shall be specified by the manufacturer's engineer (e.g., 330 lbs for 1000-gallon tanks, 450 lbs for 1500-gallon tanks; add 30 lbs for internal baffle).
- K. Holes specified for the tank shall be provided by the manufacturer. Resin or other appropriate sealant shall be properly applied to all cut or ground edges so that no glass fibers are exposed and all voids are filled.
- L. Orenco Systems<sup>®</sup>, Inc. EPDM gaskets, or approved equal, shall be used at the inlet to join the tank wall and the inlet piping. ABS or Schedule 40 PVC pipe and fittings shall be used at the inlets.
- M. Inlet plumbing shall include an inlet tee that penetrates 18" into the liquid from the inlet flow line. (The depth may vary depending on the tank's height; in all cases, though, the inlet should extend to a level below the bottom of the maximum scum depth). The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.
- N. In order to demonstrate watertightness, tanks shall be tested at the factory and again on-site prior to acceptance. Each tank shall be tested at the factory, prior to shipping, by filling with water to the soffit and letting stand for a minimum of two (2) hours. Any leakage shall be cause for rejection. After installation is completed and before backfilling, completely fill the tank with water, to a level two (2) inches into the riser. Wait a minimum of two (2) hours (or as required by local rules) and inspect the tank for leaks. There should be no drop in liquid level and no visual leakage from seams, pinholes, or other imperfections. Once the tank is proven to be watertight, drop the

water level in the tank below the invert – but not below the mid-seam.

- O. Each tank shall be marked in the uppermost surface above or near the outlet and include a permit or identification number, weight of tank, type of tank, and date of manufacture.
- P. Installation shall be in accordance with the manufacturer's recommendations, or as shown on the Contract Plans, whichever is more stringent–no variations.

## PART 2 - PRODUCTS

### 2.01 RISERS

Risers **MANUFACTURER** shall be Orenco Systems®, Inc. Risers shall be required for access to internal vaults and access into the septic tanks for septage pumping. All risers shall be constructed watertight. The risers shall be attached to the tanks such that a watertight seal is provided. Risers shall extend 3" above original grade to allow for settlement and to ensure positive drainage away from the access. Risers shall be a minimum of 30" in nominal diameter when the depth of bury is 36" or greater or duplex pumping assemblies are used. All other risers shall be a minimum of 24" in nominal diameter and shall vary in height depending on the depth of bury on the various tanks. Adhesive required to adhere the PVC or fiberglass risers to either fiberglass or ABS tank adapters shall be a two-component methacrylate structural adhesive or approved equal. To ensure product compatibility, a single manufacturer shall supply risers, lids, and attachment components.

### 2.02 INLET AND RECIRCULATING SPLITTER/BALL VALVE RISERS

Inlet risers shall be Orenco Systems®, Inc. Model Perma-Loc, Ultra-Rib, KOR FLO or engineer-approved equal. The material shall be PVC as per ASTM D-1784 and tested in accordance with AASHTO M304M-89. The risers shall be constructed of non-corrosive material and designed-to-be buried in soil. Risers shall have a minimum stiffness of 10 psi, when tested according to ASTM D2412. Risers shall be capable of withstanding a truck wheel load (54 square inches) of 2500 pounds for 60 minutes with a maximum vertical deflection of a 1/2 an inch. Risers shall extend to 3 inches above the ground surface to allow for settlement and shall have a minimum nominal diameter of 24 inches.

- Inlet & Outlet flanges grommets: insert holes for FRP style splitter valve flanges or grommets for old style splitter valves shall be drilled/installed by the manufacturer of the valve.

### 2.03 OUTLET RISERS

Outlet risers shall be Orenco Systems®, Inc. Model Perma-Loc, Ultra-Rib, KOR FLO or engineer-approved equal. The material shall be PVC as per ASTM D-1784 and tested in accordance with AASHTO M304M-89. The risers shall be constructed of non-corrosive material and designed-to-be buried in soil. Risers shall have a minimum stiffness of 10 psi, when tested according to ASTM D2412.

Risers shall be capable of withstanding a truck wheel load (54 square inches) of 2500 pounds for 60 minutes with a maximum vertical deflection of 1/2 an inch. Risers shall have a minimum nominal diameter of 24 inches for simplex pumping applications or 30 inches when used in a duplex pumping application and shall be factory-equipped with the following:

- Electrical and Discharge Grommets: when applicable, Orenco Systems<sup>®</sup>, Inc. EPDM grommets shall be installed by the manufacturer for discharge piping, vent piping, and/or the electrical conduit to assure a watertight seal. The manufacturer of the access risers shall install the grommets at the factory.

#### 2.04 RISER-TO-TANK ATTACHMENT

All attachment components shall be constructed of waterproof, non-corrosive materials, such as PVC, ABS, fiberglass, or stainless steel. Adhesives and sealants shall be waterproof, corrosion resistant and approved for the intended application. The riser-to-tank connection shall be watertight and structurally sound. The riser-to-tank connection shall be capable of withstanding a vertical uplift of 5000 pounds to prevent riser separation due to tank settlement, frost heave, or accidental vehicle traffic over the tank. Risers shall be attached to tanks with one of the following attachment systems, or approved equal:

1. Orenco Systems<sup>®</sup>, Inc. Model PRTA24 tank adapter cast into tank lid or bolted to lid using Model PRTA24BDKIT bolt down kit, and a two-component methacrylate structural adhesive.
2. Orenco Systems, Inc. Model PRTA24-2 tank adapter cast into tank lid and a two-component methacrylate structural adhesive when tank burial depth is greater than 36 inches.
3. Orenco systems, Inc. Model RRFTA30 tank adapter bolted to tank lid using RRFTA30BDKIT bolt down kit, and a two-component methacrylate structural adhesive.
4. Orenco Systems, Inc. Model PRTA30 tank adapter cast into tank lid or bolted to tank using PRTA30RBDKIT bolt down kit, and a two-component methacrylate structural adhesive.

#### 2.05 LIDS

One lid shall be furnished with each access riser. Lids shall be Orenco Systems<sup>®</sup>, Inc. DuraFiber Model FLD24G, or FLD30G or **ENGINEER**-approved equal, as appropriate, fiberglass with green non-skid finish, and provided with stainless steel bolts, and wrench. **MANUFACTURER** shall provide evidence that lids have been used successfully in continuous field service for a minimum of five years to demonstrate long-term integrity and suitability for the application. Lids shall be waterproof, corrosion resistant and UV resistant. Lids shall be flat, with no noticeable upward dome; a crown or dome of no more than 1/8" is allowable. Lids shall not allow water to pond on them. Lids shall have a green non-skid finish. Self-lubricating plastics, such as polyethylene, shall not be considered

non-skid without addition of a non-skid coating. Lids shall form a watertight seal with the top of riser. Lids shall be capable of withstanding a truck wheel load (81 square inches) of 2500 pounds for 60 minutes with a maximum vertical deflection of 3/4 of an inch. Lids shall be provided with tamper-resistant stainless steel fasteners and a tool for fastener removal. Tamper-resistant fasteners include recessed drives, such as hex, Torx, and square. Fasteners that can be removed with common screwdrivers, such as slotted and Phillips, or fasteners that can be removed with standard tools, such as pliers or crescent wrenches, are not considered tamper-resistant. To prevent a tripping hazard, fasteners shall not extend above the surface of the lid. Optional components may include the following:

1. Traffic bearing lid: The traffic bearing lid shall be a cast iron frame and cover, part number 6024, 3060, 4036, as manufactured by Sather Manufacturing Co., Inc., or approved equal, which will fit over a standard lid. The cover shall have the word SEWER cast into it.
2. Rigid closed-cell foam insulation of 2-inch or 4-inch thickness shall be attached to the underside of the lid. Any fasteners shall be made of corrosion resistant stainless steel. The insulation shall have an R-value of no less than 10 per 2-inch increment.

## **2.06 RISER INSTALLATION**

Riser installation shall be accomplished according to the **MANUFACTURER'S** instructions. For cold weather areas, risers shall be backfilled with 3/8" pea gravel or other similar granular material to prevent frost heave.

## **2.07 PUMP VAULT**

### **Standard: Flow Inducer Series**

Orenco Systems<sup>®</sup>, Inc. Model FITR Series, Flow Inducer Tower or engineer-approved equal, installed in conformance with the engineer's plans. Tower shall consist of up to five (5) 5-inch diameter PVC flow inducers each with eight (8) 2-inch diameter holes evenly spaced around the bottom. Tower will accept one to five high-head effluent pumps.

- When using a flow inducer tower within a fiberglass tank, a VB1806-FRP platform or engineer-approved equal shall be used to provide a flat stable surface for flow inducer support.

## **2.08 DISCHARGE HOSE AND VALVE ASSEMBLY**

Orenco Systems<sup>®</sup>, Inc. Model HV200BSQ or engineered-approved equal. Discharge assembly shall be 2-inch diameter and include 150 psi PVC ball valve, 200 psi PVC true union check valve, PVC flex hose with working pressure rating of 60 psi, and Schedule 40 PVC pipe with cam coupler adapter for quick disconnect. Optional components may include the following:

1. Drainback: In cold weather climates a drain-back style discharge assembly shall be used which includes an 1/8" drain back orifice above the check valve. This valve style may be used with a cold weather kit.
2. Cold weather kit: For cold weather climates and deep bury tanks, Orenco Systems<sup>®</sup>, Inc. Model Cold Weather Kit or engineer-approved equal.
3. High-pressure flex hose: Orenco Systems<sup>®</sup>, Inc. Model HVX200PR series or engineer-approved equal. Shall be constructed of a special elastomer compound with a working pressure of 250psi for systems requiring a higher horsepower pump.

## **2.09 FLOAT SWITCH ASSEMBLY**

### **Telemetry control panels:**

#### **A. Flow Equalization Tank**

Float switch shall be Orenco Systems<sup>®</sup>, Inc. Model MF4A with three switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high level/lag pump enable, timer override on/off, timer on/off and low-level alarms shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed.

#### **B. Recirculation-Blend Tank**

Float switch shall be Orenco Systems<sup>®</sup>, Inc. Model MF3A with three switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high level, timer override on/off, and low-level alarms shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed.

## **2.10 HIGH-HEAD EFFLUENT PUMP**

### **A. Simultaneous Three-Pod Dosing**

All pumps shall comply with general requirements set forth in section I (above). Orenco Systems<sup>®</sup>, Inc., Model PF7510 series or engineer-approved equal 1Hp, 230 VAC, single phase, 60 Hz, two-wire motor, with 10 foot long extra heavy duty (SO) electrical cord with ground. Pump shall be UL and CSA listed as an effluent pump.

## **2.11 ELECTRICAL SPLICE BOX**

### **External Splice Box**

Orenco Systems<sup>®</sup>, Inc. Model SBEX series external splice box or engineer-approved equal, UL approved for wet locations, equipped with up to four (4) electrical cord grips and two 3/4-inch outlet fitting. Also included shall be UL listed waterproof butt splice connectors.

## **2.12 RECIRCULATING SPLITTER/BALL VALVE**

### **Standard: MM4-FRP or MM6-FRP**

Orenco Systems<sup>®</sup>, Inc. Model MM4-FRP or MM6-FRP, 4 or 6-inch diameter ball valve assembly to provide guaranteed return of treated effluent returning from filter. The ball valve is designed to redirect 100% of flow to recirculation/dilution tank during periods of low flow or 100% to final discharge during periods of high flow. Must be manufactured of corrosion resistant PVC, Fiberglass, polyethylene and ABS components and allow for easy removal using a sliding quick-disconnect. The item is patented and the engineer knows of no equivalent.

## **2.13 DRY CHEMICAL FEEDER**

Not used.

## **2.14 CONTROLS AND ALARMS**

- A. Controls and alarms shall be listed per UL 508. Panels shall be repairable in the field without the use of soldering irons or substantial disassembly.
- B. A dedicated phone line or Ethernet cable shall be installed and is required to allow real-time connectivity with the telemetry control panel and alarm communication. Phone dialers shall not be considered as an equivalent.
- C. Panel shall be Orenco Systems, Inc. TCOM™ control panel or engineer-approved equal, meeting the following:
  - 1. Data Collection and Utilization: Logs data for system conditions and events such as pump run time, pump cycles, and alarm conditions.
  - 2. Downloadable Logs: Download logs into a \*.dif or ASCII format for simple conversion to common spreadsheet or word processor programs.
  - 3. Multi-Level Password Security: Only qualified personnel can remotely access site.
  - 4. Program Logic Rules: Simple "If ... then" declarations. Rules can be written based on several operands, including the following:
    - 5. Input/output status
    - 6. Point status
    - 7. Date: mm/dd/yy format
    - 8. Time of day: 24 hour clock
    - 9. Timers
    - 10. Historical data (allows for control optimization or detection of trends)

11. Schedule functions to control digital "Points" based on date or day of week/time.
  12. Automatic daylight savings time adjustment.
  13. Automatic call-out to pagers during alarm conditions when panel detects trends that could lead to system failure.
- D. In addition, the unit shall have the capability of real-time direct connection to the panel via laptop serial port, to allow the operator real-time access to detailed logged data and the ability to change point values.

1. Standard Components

- a. Motor-Start Contactor: 120V 16 FLA, 1 hp, 60 Hz; 2.5 million cycles at FLA (10 million at 50% of FLA). 240 VAC, 16 FLA, 3 hp, 60 Hz; 2.5 million cycles at FLA (10 million at 50% FLA).
- b. HOA 3- Way Toggle Switch: Single-pole switch, Hands (manual) Off, Auto ON. 20 amps, 1 hp.
- c. Controls Circuit Breaker: 10 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- d. Pump Circuit Breaker: 20 amps, OFF/ON switch. Single-pole for 120 VAC or double-pole for 230 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- e. Audio Alarm: 95 dB at 24", warble-tone sound.
- f. 120 VAC Ground Fault Interrupter (GFI)
- g. Current Sensor: 120 VAC with adjustable high & low alarm set points.
- h. Visual Alarm: 7/8" diameter red lens, "push-to-silence." NEMA 4, 1-watt bulb, 120 VAC.
- i. Touch Screen Display: interface module with 5.7 color touch screen.
- j. Panel Enclosure: NEMA 4X rated, constructed of UV-resistant fiberglass or NEMA 4, constructed of steel; hinges and latch are stainless steel. Conduit couplings provided.
- k. Remote Telemetry Unit: ATRTU-Net; self-powered 24 VDC at 10 mA max, 8 digital inputs, 8 analog inputs expandable to 16 with expansion board. On-board modem (9600 baud), Ethernet port (10 base T, RJ45jack) and Modbus port (R5422/485 terminals).
- l. Deadfront User interface

## 2. Optional Components

- a. Pump Run Light: 7/8" green lens. NEMA 4, 1-watt bulb, 120 VAC.
- b. Effluent Alarm: 95db at 24", warble-tone sound.
- c. Flashing Light: Lexan lens, flanged base, red, UL-recognized.
- d. Heater: Anti-condensation heater. Self-adjusting, radiates additional wattage as temperature drops.
- e. Intrinsically Safe Control Relays: 120 VAC. Listed per UL 698A, for Class 1 Div. 1, Groups A, B, C, D hazardous locations. Larger enclosure required.
- f. 3- Way (main, auto, off) manual transfer/disconnect switch
- g. Event Counter: 120 VAC, 6-digit, non-resettable.
- h. Elapsed Time Meter: 120 VAC, 7-digit, non-resettable. Limit of 99,999 hours; accurate to 0.01 hours.

### 2.15 INSTALLATION

All treatment, pumping system, and electrical components shall be installed in accordance with the **MANUFACTURER'S** recommendations, the engineer's plans, and all state and local regulations.

### 2.16 LOCATION

The pump control panel shall be mounted on an exterior backboard or inside a control building nearest to the tank and pumps. If mounting to an exterior wall, try to select a garage or outbuilding where the sound of the motor contactor engaging will not be noticed. If a garage or outbuilding wall isn't available, installation should include use of sound-deadening insulation. (Post and panel mounting assemblies are acceptable.) The control panel shall be located within 50 feet and in sight of the pump motor or shall be provided with a lockable disconnect switch. The panel, when possible, should be mounted in the shade and protected from the weather. The panel should be located at a convenient height (usually about five feet above the ground) and where it will be accessible for maintenance.

### 2.17 AX100 ADVANTEX TREATMENT SYSTEM

Orenco Systems<sup>®</sup>, Inc. AX100 AdvanTex<sup>®</sup> Treatment System shall be installed in conformance with the engineer's plans and manufacturer's guidelines. The AX100 is a packed bed filter consisting of a proprietary textile media housed in a 16' x 8' x 3.5'. The media has been specifically engineered for wastewater applications. The item is patented and the engineer knows of no equivalent.

### 2.18 ADVANTEX<sup>®</sup> VENTILATION SYSTEM

A. Ventilation system shall be a passive system and include air intake and exhaust ports on each pod.

## PART 3 – EXECUTION

### 3.01 PRECONSTRUCTION CONFERENCE

Before any work at the site is started, a conference attended by the **OWNER, CONTRACTOR, ENGINEER, MANUFACTURE, OPERATOR** and others as appropriate will be held to establish a working understanding among the parties as to the work involved for installing each component of the treatment system. At this conference, the **OWNER, CONTRACTOR, ENGINEER, and MANUFACTURE** shall designate, in writing, a specific individual to act as **INSPECTOR** for the installation of the treatment system. Any cost or fees associated with the services of the **INSPECTOR** or the **ENGINEER** during construction will be the responsibility of the **OWNER**.

### 3.02 INSTALLATION AND FIELD TESTING TRAINING

The **MANUFACTURER** shall provide the services of a trained representative to instruct the installing **CONTRACTOR'S** crew and **INSPECTOR** regarding the proper installation and field testing of each component per the **MANUFACTURE'S** recommendations and requirements. The **MANUFACTURER** shall have a trained representative provide installation and field testing training services for a minimum of one (1) visit of a minimum of one (1) eight-hour day at the beginning of construction.

### 3.03 QUALITY CONTROL

- A. To ensure quality control, the **INSPECTOR** shall inspect and certify that an initial installation of the AdvanTex<sup>®</sup> system is in compliance with the **MANUFACTURE'S** recommendations and requirements.
- B. Upon completion of the inspection, the **INSPECTOR**, in coordination with the **ENGINEER**, shall perform or direct the **CONTRACTOR** to perform any required adjustments to the equipment and place into operation under the supervision of the **ENGINEER**. All equipment and materials required to perform the testing shall be the responsibility of the **CONTRACTOR**. A letter of completion shall be signed by the **INSPECTOR** and copies faxed, emailed, or mailed to the **ENGINEER** and **MANUFACTURE** within one (1) week of the AdvanTex<sup>®</sup> system being installed and prior to System Commissioning.
- C. The **MANUFACTURER** shall provide the services of a trained representative for a minimum of one (1) visit of a minimum of one (1) eight-hour day for the purpose of quality control during construction.

### 3.04 SYSTEM COMMISSIONING

- A. The **MANUFACTURER** shall provide the services of a trained representative for training the **OWNER'S** service provider, and inspecting the AdvanTex<sup>®</sup> installation. The inspection will include items covered from the installation training. Upon system commissioning, the **MANUFACTURER'S** trained representative shall provide the **ENGINEER** a written report of findings. The **ENGINEER** should then perform or direct the **CONTRACTOR** to perform any required adjustments to the equipment and place into operation. All equipment and materials required to perform additional testing shall be the

responsibility of the **CONTRACTOR**. The **MANUFACTURER** shall submit to the **ENGINEER** and **OWNER**, a detailed start-up checklist, according to the manufacturer's inspection and startup procedures.

- B. The **MANUFACTURER** shall provide the services of a trained representative for a minimum of one (1) visit of a minimum of one (1) eight-hour day for the purpose of system commissioning.

### **3.05 MANUFACTURER SITE VISITS**

- A. The **MANUFACTURER** shall provide the services of a manufacturer's representative for a minimum of three (3) visits of a minimum of one (1) eight-hour day each. The visits shall be for the following:

1. INSTALLATION AND FIELD TESTING TRAINING
2. QUALITY CONTROL
3. SYSTEM COMMISSIONING

- B. The visits shall be scheduled after the Pre-Construction Meeting and after an Inspector is designated.

### **3.06 SPARE PARTS**

The **MANUFACTURER** shall provide a spare pump, six (6) spare floats, check valve, control components, and nozzles, and various other necessary components deemed necessary.

### **3.07 OPERATION AND MAINTENANCE**

The **MANUFACTURER** shall provide five (5) operation and maintenance manuals, four (4) to be sent to the **OWNER**, and one (1) sent to the **ENGINEER**.

**END OF SECTION**

## SECTION 16010

### GENERAL PROVISIONS - ELECTRICAL

#### PART 1 - GENERAL

##### 1.01 RELATED REQUIREMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and other Division 16 Specification Sections shall apply to this Section of the specifications.

##### 1.02 GENERAL ELECTRICAL REQUIREMENTS

- A. The electrical drawings are diagrammatic in nature and are intended to indicate the general arrangement and quantity of electrical devices, equipment and circuiting. Field-verify dimensional requirements, locations and levels of all electrical equipment with actual site conditions.
- B. Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduits shall have tapered threads.
- C. Furnish all labor, materials, and equipment necessary to obtain a complete and functional electrical system as indicated on the drawings and as required by the specifications.
- D. Furnish all permits and fees required for completion of the electrical work.
- E. Review the drawings and specifications of other Divisions associated with this project, and provide electrical devices and circuiting for the proper operation of all electrical devices requiring electrical connections.
- F. Provide all required guards, barriers, signs and miscellaneous items at electrical equipment to insure the safety of personnel during the duration of construction.
- G. The installation of all electrical equipment shall be coordinated with the installation of equipment from all other Divisions of the specifications.
- H. Discrepancies in the drawings or specifications shall be brought to the attention of the Owner's Representative prior to the bid date.

### 1.03 QUALITY ASSURANCE

- A. All electrical products furnished under Division 16 specifications shall be new products that are UL listed and labeled. Electrical products shall be used for the application for which they are UL approved.
- B. All electrical products furnished for this project, where applicable, shall be rated for the seismic zone classification for the geographic location of this facility.
- C. Installation of electrical wiring and devices specified in Division 16 shall comply with the applicable edition of all national, state, and local codes and ordinances, and the requirements of the local authority having jurisdiction. The electrical installation shall comply with but not be limited to the following:
  - 1. The National Electric Code (NFPA 70).
  - 2. The National Electric Safety Code.
  - 3. Standard Fire Prevention Code.
  - 4. All applicable building codes, including but not limited to the 2006 International Building Code.
  - 5. All applicable local electric codes.
  - 6. Occupational Safety and Health Act (OSHA).
  - 7. Americans with Disabilities Act (ADA).
  - 8. The requirements of the local power and telephone companies providing services to the project.
- D. Electrical products furnished for installation under Division 16 of the specifications, where applicable, shall adhere to the latest industry guidelines and standards of the following associations:
  - 1. ANSI – American National Standards Institute
  - 2. CBM – Certified Ballast Manufacturers
  - 3. EIA – Electronics Industry Association
  - 4. IEEE – Institute of Electrical and Electronics Engineers
  - 5. IESNA – Illuminating Engineering Society of North America
  - 6. NEMA – National Electrical Manufacturers Association
  - 7. UL – Underwriter's Laboratories

### 1.04 SUBMITTALS

- A. Submit (7) copies of all electrical items proposed to be furnished under Division 16 specifications for approval. See individual sections for specific submittal requirements.

- B. Furnish submittals for all electrical items at the same time. Partial electrical submittals are not acceptable.
- C. Submit sufficient information to allow verification that the item submitted meets the requirements of the drawings and specifications. Include operating characteristics including but not be limited to voltage, amperage, phase, KVA, wattage, horsepower, NEMA ratings, dimensions, etc.
- D. Submittals shall be furnished in three-ring binders, and shall include an index page, and tabbed sections.

#### 1.05 COORDINATION

- A. Verify and coordinate the location of all existing and proposed new underground utilities prior to beginning electrical site work.
- B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work.
- C. Sequence, coordinate, and integrate installation of electrical materials and equipment for efficient flow of the electrical work.
- D. Coordinate the installation of equipment specified in other Divisions of the specifications for installation under Division 16 specifications.
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before the ceiling installation.

#### 1.06 TEMPORARY CONSTRUCTION POWER

- A. Furnish all temporary lighting, power equipment, and circuiting required for the construction to be completed under this contract. Temporary wiring shall meet all applicable codes, ordinances and safety regulations, and shall be furnished with ground fault protection for all circuits provided.
- B. Furnish a temporary electrical service to this project as required to accommodate the temporary power needs of all construction disciplines. Include all fees and permits required for a temporary electrical service.
- C. Remove all temporary electrical services, wiring, and devices upon completion of the project.

## 1.07 ELECTRICAL EQUIPMENT SUPPORTS

- A. Furnish and install all necessary steel members, frames, connections, etc. to support equipment installed under Division 16. Support members shall be rigidly attached to building structural members using clamps and accessories which do not permanently modify the structural member. All supports shall be sized to adequately support the equipment being installed, and shall be designed in accordance with specification Section 16070, Seismic Protection for Electrical Equipment.
- B. Welding, drilling, or other modifications to structural members or equipment is not allowed.
- C. All support hardware shall include lock washers.
- D. Supports for large pieces of electrical equipment and large feeders shall be designed to place a symmetrical load on the structural supporting members.
- E. All electrical strut supports used outdoors shall be galvanized steel. Strut used indoors in dry locations may be painted steel.

## 1.08 CONCRETE BASES

- A. Furnish and install concrete forms and reinforcement materials as indicated on the drawings, as required in the specifications, and as otherwise required for proper support and operation of electrical equipment furnished under Division 16. Concrete bases for equipment shall be designed and installed in accordance with specification Section 16070, Seismic Protection of Electrical Equipment.
- B. Furnish and install concrete housekeeping pads with chamfered edges for all floor mounted electrical equipment.
- C. Concrete shall be 3000-psi (20.7-MPa), 28-day compressive strength minimum.

## 1.09 EXCAVATION AND BACKFILL

- A. Furnish all equipment and labor required to perform all excavation required for the installation of equipment and work specified under Division 16. Verify all existing underground utilities and proposed locations for new underground utilities prior to beginning excavation work.
- B. Furnish all required backfill material. Backfill material shall be installed and compacted in 6" layers, with compaction equal to the surrounding

undisturbed soil. Conduits located in trenches shall be anchored to prevent displacement during backfill.

- C. Excess excavated material shall be disposed of off-site in accordance with all applicable codes and regulations.

#### 1.10 TESTS AND ADJUSTMENTS

- A. Furnish all equipment, materials and labor required to test all equipment and wiring installed under Division 16 specifications.
- B. All tests and adjustments shall be made prior to acceptance by the local Code Authority having jurisdiction.
- C. All electrical equipment and wiring found to be defective shall be promptly replaced at no additional cost.
  - 1. All tests shall be made in accordance with manufacturer's recommendations and accepted industry standards and practices. All tests shall be recorded. Furnish (2) copies of all test reports to the Owner.

#### 1.11 OPERATIONS AND MAINTENANCE MANUALS

- A. Furnish three copies of operations and maintenance manuals for all electrical equipment installed under Division 16 specifications. Manuals shall be furnished in three-ring binders, and shall include and index and tabs for all sections.
- B. Operations and maintenance manuals shall include the manufacturer's recommendations for installation, operation, maintenance, repair and troubleshooting of electrical equipment. Include parts list, schematic diagrams, and the name, address and telephone number of factory approved equipment suppliers and service organizations.
- C. Furnish one complete approved set of electrical submittals in each operations and maintenance manual.
- D. Include complete control system schematics and wiring diagrams in the operations and maintenance manuals.

#### 1.12 STARTUP SERVICES AND TRAINING

- A. Furnish services of a factory trained and authorized technician for the checkout and startup of all electrical equipment and systems. Include

printed documentation for all required adjustments, settings, and program setpoints.

### 1.13 TOUCHUP PAINTING

- A. Furnish and install touchup paint for all scratches and minor finish damage to electrical equipment. Touchup paint shall be equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized surfaces shall be touched up with zinc-rich paint recommended by the equipment manufacturer.
- C. Electrical equipment with damage greater than minor surface scratches shall be replaced with new equipment. Replace all equipment and enclosures that have visible deformation or damage from shipping, handling, or installation.

### 1.14 WARRANTIES

- A. All electrical wiring, equipment, and devices installed under this project shall be warranted for a period of (1) year. This warranty shall be concurrent with, and shall not supersede any warranties from any other division of the specifications, or specific warranties that exceed this time period in other Division 16 specification sections. This warranty shall include all parts, labor, and materials.

## **PART 2 - PRODUCTS**

### 2.01 GENERAL

- A. See individual specification sections for electrical product requirements.

## **PART 3 - EXECUTION**

### 3.01 ELECTRICAL EQUIPMENT INSTALLATION

- A. The electrical installation shall conform to requirements of NFPA 70 and to the requirements specified herein.
- B. Install electrical materials and equipment in accordance with the manufacturer's written instructions, and in compliance with Specification Section 16070, Seismic Protection for Electrical Equipment.
- C. Arrange and install electrical equipment and components to provide the maximum possible headroom.

- D. Install electrical materials and components level, plumb, and parallel and perpendicular to other building systems and components.
- E. Install electrical equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations. All clearances in front of and around electrical equipment required by Code or local authorities having jurisdiction shall be observed.
- F. Piping systems requiring slope shall take precedence over installation of electrical equipment and conduits.
- G. Furnish all appropriate and required lifting and hoisting equipment required for the proper installation of all electrical equipment. All lifting and hoisting of electrical equipment shall be completed in accordance with the electrical equipment manufacturer's written requirements. Any equipment damaged in the process of shipping or installation shall be removed and replaced with new equipment at no additional cost to the Owner. Any equipment which sustains enclosure deformation due to shipping or installation, and any equipment damaged due to improper storage, shall be replaced with new equipment at no cost to the Owner.
- H. Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

### 3.02 STORAGE OF ELECTRICAL EQUIPMENT AND MATERIALS

- A. All electrical materials and equipment installed on this project shall be stored in a clean, dry, non-condensing environment.
- B. Major pieces of electrical equipment shall not be shipped or stored on site until the facilities that will house them have been completed to the point of providing a dry and controlled environment. Major pieces of electrical equipment shall be shipped to the project site and immediately placed in the final installation position.

### 3.03 FIELD QUALITY CONTROL

- A. Check all installed electrical components for damage and faulty work, and replace any items found to be defective or damaged.

### 3.04 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved. Any modifications of building structures shall be approved by the Structural Engineer responsible for the building design.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Repair and refinish work shall be completed by skilled mechanics of the trades involved.

### 3.05 CLEANING AND PROTECTION

- A. On completion of electrical installation, clean and inspect electrical devices and finishes. Remove burrs, dirt, paint spots, and construction debris from surfaces and from within enclosures and junction boxes.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and enclosures are without damage or deterioration at time of Substantial Completion.

### 3.06 CONCRETE BASES

- A. Concrete bases shall be of dimensions shown (where indicated), but not less than 4 inches (100 mm) larger, in both directions, than the supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement.
- B. Concrete bases for equipment shall be designed and installed in accordance with specification Section 16070, Seismic Protection of Electrical Equipment.

### 3.07 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint.
  - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
5. Any electrical equipment which has more than minor superficial finish scratches shall be replaced with new equipment.

**END OF SECTION**

**SECTION 16075**  
**ELECTRICAL IDENTIFICATION**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.03 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

**PART 2 - PRODUCTS**

2.01 RACEWAY AND CABLE LABELS

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
  - 1. Color: Black letters on orange field.
  - 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.
- C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

- E. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
  - 1. Not less than 6 inches wide by 4 mils thick.
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend indicating type of underground line.
- F. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

## 2.02 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

## 2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength: 50 lb minimum.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: According to color-coding.
  
- B. Paint: Formulated for the type of surface and intended use.
  - 1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
  - 2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
  - 3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
  - 4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
  
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
  
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
  
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
  
- E. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background. Identify the following:

1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
  2. Wall surfaces directly external to conduits concealed within wall.
  3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
  4. Entire surface of exposed conduits.
- F. Install painted identification according to manufacturer's written instructions and as follows:
1. Clean surfaces of dust, loose material, and oily films before painting.
  2. Prime surfaces using type of primer specified for surface.
  3. Apply one intermediate and one finish coat of enamel.
- G. Exposed Cables: Band exposed of the systems listed below:
1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, and place adjacent bands of two-color markings in contact, side by side.
  2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
  3. Apply the following colors to the systems listed below:
    - a. Fire Alarm System: Red.
    - b. Fire-Suppression Supervisory and Control System: Red and yellow.
    - c. Combined Fire Alarm and Security System: Red and blue.
    - d. Security System: Blue and yellow.
    - e. Mechanical and Electrical Supervisory System: Green and blue.
    - f. Telecommunication System: Green and yellow.
- H. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage

with black letters on orange background. Install on exterior of door or cover.

- I. Circuit Identification Labels on Boxes: Install labels externally.
  1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
  2. Concealed Boxes: Permanent marker on cover showing circuit ID.
  
- J. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
  
- K. Color-Coding of Secondary Phase Conductors: Use the following colors for service, feeder and branch-circuit phase conductors:
  1. 208/120-V Conductors:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  
  2. 480/277-V Conductors:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  
  3. Factory apply color the entire length of conductors, except the following field-applied color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
    - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
  
  4. See Section 16060 "Grounding and Bonding" for color coding of grounding and isolated grounding conductors.

- L. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
  - 1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
  - 2. Tag Fasteners: Nylon cable ties.
  - 3. Band Fasteners: Integral ears.
  
- M. Apply identification to conductors as follows:
  - 1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
  - 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
  - 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
  
- N. Apply warning, caution, and instruction signs as follows:
  - 1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
  - 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
  
- O. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for

each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Electrical switchgear and switchboards.
4. Emergency system boxes and enclosures.
5. Disconnect switches.
6. Enclosed circuit breakers.
7. Motor starters.
8. Push-button stations.
9. Power transfer equipment.
10. Contactors.
11. Remote-controlled switches.
12. Dimmers.
13. Control devices.
14. Transformers.
15. Fire alarm master station or control panel.

**END OF SECTION**

**SECTION 16130**  
**RACEWAYS AND BOXES**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUITS, TUBING, AND FITTINGS**

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. IMC: Comply with ANSI C80.6 and UL 1242.
- D. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- F. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

### **2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS**

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC,.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Minimum Raceway Size: 1/2-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- C. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- D. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- E. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- F. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
  - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 02300 "Earthwork" for pipe less than 6 inches in nominal diameter.
  - 2. Install backfill as specified in Section 02300 "Earthwork."
  - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 02300 "Earthwork."
  - 4. Install manufactured rigid steel duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 16075 "Electrical Identification."

**END OF SECTION**