DIVISION 11 - EQUIPMENT

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SECTION 11200

INTERIOR PROCESS PIPING AND VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions, Division 0 and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY OF WORK

A. The work covered under this Section of the Specifications includes the furnishing of all labor, equipment, appliances, and materials, and in performing all operations in connection with the furnishing, installation, and testing of interior process piping systems, including piping, pipe fittings and specials, mechanical couplings, victaulic couplings, wall seals and fittings, valves, flexible pipe connectors, strainers, jointing materials, pipe hangers and supports, and accessories of the various materials, sizes, classes, joints, and types, and appurtenant work, at the locations and to the general arrangements and details as indicated and/or as directed, complete in place, in accordance with the Contract Drawings and Specifications.

B. Related sections include the following:

1. Division 0 – Bidding and Contract Requirements

2. Division 1 – General Requirements

3. Division 11 – Equipment

1.3 SUBMITTALS

A. Submittals shall be in accordance with the Conditions of the Contract and Division 1 Specifications Sections.

B. Shop Drawings: Include materials lists, catalog cuts, and complete specifications for all piping materials including gaskets and connections. Shop drawings for all valves, valve operators, strainers, hangers and supports, wall seals and sleeves, flexible connections, cleanouts, and other like manufactured items. Detailed piping layout drawings of all interior and exterior piping and valves including location, type, and number of proposed pipe supports. Drawings of exterior piping shall also show the relationship between the work included in this Section and that included in others where in close proximity.

C. Operation and Maintenance Manuals: Submit materials for inclusion in Operating and Maintenance Manuals specified in Division 1.

D. Welding Qualifications:

1. Weld Inspection and Testing Agency: Certification and qualifications.

2. Welding Inspector: Certification and qualifications.

3. Welders:

a. List of qualified welders and welding operators.
b. Current test records for qualified welder(s) and weld type(s) for factory and field welding.

4. Weld Procedures: Records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).

5. Nondestructive inspection and testing procedures.

6. Test logs.

7. Certified welding inspection and test results.

F. Quality Assurance Qualifications

1. Independent Inspection and Testing Agency:

a. Ten years' experience in field of welding and welded pipe and fittings' testing required for this Project.
b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
c. Certified in accordance with ASNT SNT TC 1A for testing procedures required for this Project.
d. Testing Personnel: Qualified for nondestructive test methods to be performed.
e. Inspection Services: Qualified welding inspector.

2. Welding Inspector: AWS certified, AWS QC 1 qualified, with prior inspection experience of welds specified.

3. Welder and Welding Operator Qualifications:

a. Qualified by accepted inspection and testing agency before starting work in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

b. Qualified to perform groove welds in Positions 2G and 5G for each welding process and pipe material specified.
c. Qualification tests may be waived by Engineer based on evidence of prior qualification.

G. Quality Control: Provide services of independent inspection and testing agency for welding operations.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – Quality Assurance and as specified.

B. The materials and equipment covered in this specification are intended to be standard materials and equipment of proven ability as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the best practice of the industry and shall be installed in accordance with the manufacturer's recommendations and these Specifications. The Specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

1.5 DELIVERY, STORAGE AND HANDLING

A. Setting miscellaneous material. All anchors, bolts, inserts, supports, pipe wall fittings, pipe sleeves and such other materials occurring in connection with concrete and masonry work shall be furnished and placed accurately and maintained securely in position to lines and grades at the time of concrete and masonry placement. All necessary templates shall be provided.

B. Drawings are diagrammatic and do not attempt to show each and every offset or all fittings. All changes and adjustments to the drawing layouts as required for conformity of the work to the structures as constructed, to equipment, to approved shop drawings, or to fit work of other trades shall be as approved by the Owner, and shall be included as part of the work under this Section of the Specifications at no additional expense to the Owner.

1.6 PIPE SCHEDULE

A. Pipes, fittings and specials, appurtenances, and jointing shall be in accordance with the following schedule. This schedule is set forth as a guide as to types of materials and jointing required. The lack of mention of any specific pipe shall not relieve the Contractor from the responsibility of furnishing and installing all piping as required for the principal piping systems included under this Section of the Specifications and is presented herein for convenience of references for the Contractor.

PIPING SYSTEM	PIPE MATERIAL AND JOINTING
Pump Discharge	Flanged D.I. pipe, D.I. fittings and specials; pipe, fittings, and specials to be cement mortar lined, thickness class as specified herein.

PART 2 - PRODUCTS

2.1 GENERAL

A. The following describes equipment, materials and services necessary to provide a complete, functional interior process piping and valves system. The interior process piping and valves system shall be a complete package that contains:

- Pipes
- Wall Seals and Sleeves
- Valves
- Valve Tags
- Pipe Support Systems

B. The interior process piping and valves system components shall arrive assembled with piping and valves system shop-assembled/installed to the fullest extent possible given the site, building, and access constraints. All other appurtenances mentioned herewith shall also be included for a complete and operational system.

2.2 PIPES

A. Ductile Iron (DI) Pipe and Pipe Fittings. Ductile iron pipe shall be classified by Underwriters Laboratories Inc., in accordance with ANSI/AWWA A21.15/C115.

1. Ductile iron pipe shall conform to the physical and chemical requirements of ANSI/AWWA A21.51/C151, and shall have dimensions and wall thicknesses and flanges in accordance with ANSI/AWWA A21.15/C115, Pressure Class 250 psi.

2. Cement-mortar linings: ductile iron pipe, cast iron and ductile iron pipe fittings and specials, where indicated, shall be double thick cement-mortar-lined in accordance with ANSI Specification A 21.4. Thickness of the mortar lining shall be 1/8-inch for pipe 12-inches and smaller and 3/16-inch for pipe larger than 12-inches.

3. Exterior Coating: The exterior surfaces of all other pipe and fittings shall be thoroughly cleaned and given one shop coat of manufacturer's recommended primer. The coating used shall be compatible with the coats to be field

applied. The shop coat shall be applied in accordance with the paint manufacturer's recommendations.

4. Ductile iron pipe, cast iron or ductile iron pipe couplings, fittings and specials shall have cast upon them the class, thickness designation and initials of the manufacturer.

4. Ductile Iron push-on and mechanical joints shall be in accordance with ANSI/AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings".

5. All flanged joints for ductile iron pipe shall be made with bolts or bolt studs with a nut on each end and SBR rubber gaskets extending at least to the inside of the bolts. SBR rubber gaskets shall conform to AWWA C111 latest revision. Bolts and nuts shall be carbon steel, except if noted otherwise on the Drawings. Bolt studs and nuts shall be of the same quality as machine bolts. After fastening nuts to bolts or threaded rods, the threads of the bolt/rod shall extend a minimum of ½ inch outward from the face of the nut. A sample of the gaskets shall be submitted to the Engineer for approval.

2.3 WALL SEALS

A. For pipe penetrations through existing reinforced concrete floors, and wall brick or concrete and masonry unit walls, Contractor shall core hole through concrete of sufficient of diameter for pipe and annular space to accommodate seal. Cast-iron wall sleeves shall not be used for penetrations through existing concrete or brick walls or floors.

B. The annular space created by the wall sleeve and the pipe or the existing concrete and the piping shall be positively sealed with "Link Seal", manufactured by Thunderline Corporation, or an approved equal. Seals shall be the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members.

C. The Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing the seals. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint.

D. The Contractor shall be familiar with the installation of the seals according to the manufacturers' instruction bulletin which illustrates the proper procedure for installing and tightening the seal to provide a water-tight pipe penetration.

2.4 VALVES

A. General:

1. The valves shall be suitable for wastewater applications.

2. Full-port design unless noted otherwise.

3. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

4. Valves in Insulated Piping: With minimum 2-inch stem extensions or greater as required to clear the insulation and jacketing.

5. Valve Sizes: Same as upstream piping unless otherwise indicated.

6. Valve-End Connections:

   a. Solder Joint: With sockets according to ASME B16.18.
   b. Threaded: With threads according to ASME B1.20.1.
   c. Hose-End: Male hose-end, ¾" with chained cap and gasket for drain valves.

7. EPA Compliance: EPA Safe Water Drinking Act for potable water service.

8. NSF Compliance: NSF 61 for valve materials for potable-water service.

B. Check Valves

1. Check valves shall be rubber seated dampened swing check with outside counter weight and lever and shall meet the requirements of AWWA C508. The valve shall permit flow in one direction only and close tightly without slamming. The valve shall be cast iron (ASTM A126-13) with cast iron disc of similar material. The hinge shaft shall be stainless steel with disc arm and counterweight arm keyed thereon. The body seat shall be all bronze or stainless steel.

2. The valves shall be compatible with 125 pound ANSI drilled flange. Valves shall be cleaned and shop primed on the outside with a rust inhibitive priming system. The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.

3. The top access port shall allow for the removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc.

4. The disc shall be of one-piece construction.

5. Manufacturers:

a. Val-Matic, Co
b. Dezurik, Inc.
c. Henry Pratt Company
d. Or Engineer Approved Equal

2.5 VALVE TAGS

A. All valves in piping except individual valves provided with equipment shall be tagged with an aluminum or brass disc, wired to the valve, die-stamped with identifying numbers or letters.

B. A flow diagram, identifying number and duty of each tagged valve, framed under safety glass, shall be furnished and mounted by the Contractor in the control room, at major equipment, or as directed by the Engineer.

2.6 PIPE SUPPORT SYSTEMS

A. All supports and parts required for the installation of the piping systems shall conform to the requirements of Chapter 1, Section 6 of the ANSI Code for Pressure Piping (B-31.1), except as modified and supplemented by the requirements set forth herein. All piping shall be supported in such a manner to fulfill this specification. Pipe supports and restraints shall be adequate for the maximum test pressure specified herein or 1.5 times the apparent working pressure, whichever is greater. General contractor shall provide all pipe supports for piping, valves, equipment, and ancillary items described within Division 11.

1. Supporting appurtenances shall be arranged to prevent undue stress on equipment to which piping is connected. Supporting system shall be arranged without causing damaging deflection to the support member. Supporting appurtenances shall provide the desired pitch, as specified or required, for proper drainage of the piping. The pipe suspension shall prevent excessive stress, excessive variation in supporting force, and possible resonance with imposed vibration while the system is in operation. Supporting appurtenances, when used with copper piping, shall be copper, bronze or PVC dipped galvanized steel.

2. All piping shall be supported independent of the equipment to which it is connected. All equipment shall be removable without needing temporary supports for adjacent piping. Any anchors for all supporting appurtenances shall be drilled expansion bolt type, power driven stud anchors are not acceptable. Expansion bolts shall be stainless steel, similar and/or equal to Kwik-Bolt.

3. All metallic supporting appurtenances, except those used for copper piping, and as otherwise noted, shall be galvanized conforming to ASTM A-153 for threaded items, and ASTM A-123 for all other items. Supporting appurtenances in the classified and high humidity areas shall be stainless steel. Normal humidity service shall be defined as all spaces where there are no water-containing open tanks or channels. High humidity service shall be defined as any spaces near open water-containing tanks or channels. Hangers shall not become disengaged by movements of the supported pipe. Lock nuts shall be used on all hangers. All piping systems shall be supported by hangers that can vertically adjust for the leveling of lines after piping is in place. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing. All hanger rods, except those that are stainless steel, shall conform to ASTM A-575. Hanger rod diameters shall be as recommended by pipe hanger manufacturers for the type of pipe, hanger size, and spacing used.

4. Piping shall be supported according to the Spacing Schedule below, and/or the MSS Standard Practice SP-69, (Manufacturers Standardization Society of the Valve and Fitting Industry), whichever spacing is closer. A support shall also be located within four inches of each side of all fittings and valves. Vertical runs of pipe shall be supported independently of the connected horizontal runs. All vertical pipes shall be supported at each floor or at intervals not greater than ten feet, by approved pipe collars, clamps, brackets or wall rests. Hangers shall be placed on each side of a flexible coupling, as close to the coupling as possible. At expansion joints, hangers supporting the flexible couplings shall be placed on either side of the joint. Hangers shall prevent transverse movement.

SPACING SCHEDULE*, **

PIPE SIZE (INCH)	STEEL PIPE SCH. 20-80 (FEET)	STAINLESS STEEL (FEET)	COPPER PIPING (FEET)	DUCTILE IRON PIPE (FEET)	C/PVC PIPE (FEET)
½	5	-	5	-	3
¾	6	-	6	-	3
1	7	-	6	-	3.5
1 ½	9	-	8	-	3.5
2	10	10	9	6	4
2 ½	11	-	10	-	4.5
3	12	-	10	6.5	4.5
3 ½	13	-	11	-	-
4	14	10	12	8.5	5
6	17	10	14	9	6

PIPE SIZE (INCH)	STEEL PIPE SCH. 20-80 (FEET)	STAINLESS STEEL (FEET)	COPPER PIPING (FEET)	DUCTILE IRON PIPE (FEET)	C/PVC PIPE (FEET)
8	19	10	14	10.5	6.5
10	22	10	15	12	-
12	23	10	17	13	6.5

* Additional supports and restraints at bends shall be installed for all pump system piping as necessary to prevent deformation and movement of the pipe under maximum flows and pressures.

** C/PVC pipe spacing schedule based on uninsulated pipe carrying liquid having a specific gravity of 1.0 and a temperature of 120 degrees Fahrenheit.

5. If the pipe to be supported is not listed, then the spacing for the next smaller pipe size shall be used. There shall be a minimum of one support per pipe lay length on uninterrupted horizontal runs. This support shall be placed within one foot of the joint. If the pipe manufacturer recommends a smaller spacing interval than specified herein, then the manufacturer's spacing shall be used.

6. All supports, saddles, bearing plates, and hangers shall provide by direct contact, a minimum of 80° support around the pipe, except as specified herein. Where continuous concrete inserts are used, the maximum concentrated load on the end two inches of inserts, with laying lengths of eight inches or longer, shall not be more than 50 percent of the maximum recommended channel loading.

B. Concrete pipe saddles shall cradle horizontal piping when it is supported from below. Where space limitation prevents using concrete pipe saddles, steel pipe saddles shall be used.

C. Base elbows, tees and concrete pedestals shall be provided at all vertical runs of pipe and shall be supported on a base elbow and/or concrete pedestal. All concrete supports shall be formed up to the spring line of the pipe. After completion of curing, piping shall be adjusted to the proper grade.

D. Pipe support framing system shall be designed by a qualified engineer retained by the Contractor and installed according to the design and per pipe manufacturer's recommended procedure. Pipe support and restraint system shall be designed to support the pipe's weight, pipe reaction from the flow and lateral seismic forces stipulated in the applicable provisions of the Massachusetts State Building Code, 8th edition.

1. All pipe support and restrain framing system shall be hot dipped galvanized in conformance with ASTM A-123.

2. All structural steel wide flanges, channel, angles and plate materials shall conform to ASTM A-36. All structural steel tubing shall conform to ASTM A-500 Grade B.

3. Steel fasteners to conform to ASTM A-307 or A-325.

4. Fittings shall be hot rolled steel, conforming to ASTM A-307 or ASTM A-575.

5. All welding shall be performed by qualified welders and in conformance with applicable provisions of the AWS.

6. When condition allows, metal framing system as manufactured by Uni-strut, Globe-Strut, Power Strut, or equal, may be used for supporting the piping system.

E. Restraints

1. All valves and fittings shall be restrained, so that all thrusts shall be supported independent of the piping system. Thrust shall not be supported by walls unless specifically designed for and indicated on Contract Drawings. All restraints shall conform to pipe manufacturer's recommendation.

2. For interior piping, restraints shall be located as follows:

   a. Anchors shall be placed so all forces will be balanced.
   b. Tie downs shall be used to hold the pipe in position where velocity and surge forces will cause pipe movement. They shall control stress due to thermal expansion at wall pipes, sleeves and equipment.

F. Guides shall be used to prevent transverse motion at flexible couplings used as expansion joints.

1. Tie Rods: On piping, where flexible couplings are located near fittings or valves, stainless steel tie rods shall span the coupling from the two adjacent flanges. Such restraints can be deleted at the discretion of the Engineer, if both pipe ends are anchored in a concrete structure with no fitting or valve within the span. Where the Engineer intends to have flexible couplings used as expansion couplings, tie rods may be omitted. All tie rods shall be sized, spaced and installed according to the manufacturer's recommended procedure, or as directed by the Engineer.

2. Restrained Joints: Where indicated on Contract Drawings, restrained joints shall be installed. Restraints shall be Megalug as manufactured by Ebaa Iron Co., or approved equal. Restraints for push-on joints shall be series 800 coverall as manufactured by Ebaa Iron Co., or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Handling of Pipe. The loading, hauling, unloading and handling of pipes and appurtenances shall be accomplished without damage to same. Dropping of pipe and appurtenances directly to the ground or floor will not be permitted. Suitable buffers or runners shall be provided. The Contractor shall be liable for any damage to the pipe or appurtenances until they are accepted in the completed work. Each pipe section shall be handled into its final position only in such a manner and by such means as the Engineer approves as satisfactory, and these operations will be restricted to those considered safe for the workmen and such as to cause no injury to the pipe or to any property. As far as practicable, the Contractor shall be required to furnish slings, straps, and/or approved devices to provide satisfactory support of the pipe when it is handled.

B. Tools for Pipe Installation. The Contractor shall furnish all tools, torque wrenches, materials and labor necessary to make the joints in pipe in strict accordance with the manufacturer's specifications. Proper and suitable tools and appliances for the safe and convenient handling and installation of pipes shall be used. The Contractor shall exercise reasonable precaution during his operation in order to avoid damaging the material. All pipes, fittings or appurtenances which are so damaged shall be replaced by him at his sole expenses.

C. Installation. All materials and equipment shall be installed in a neat workmanlike manner, and as recommended by the manufacturer. All piping shall be installed true to line and grade and rigidly supported. Before setting wall sleeves and pipes to be cast-in-place, the Contractor shall check all plans and figures which may have a direct bearing on his pipe location and he shall be responsible for the proper location of his pipes during the construction of the buildings. All interior piping shall have sufficient number of unions or their equivalent to allow convenient disassembly and removal of piping. All valves and appurtenances shall be installed in accordance with manufacturer's directions at locations shown on the drawings. All in-line devices provided under instrumentation shall be installed as part of the work of this section.

D. Cleaning and Plugging Pipe. The pipes and fittings shall be thoroughly cleaned before being installed and shall be kept clean until accepted in the finished work. The ends of all uncompleted lines shall be tightly closed with temporary plugs at all times when pipe installation is not in progress to prevent foreign material from entering the pipe.

E. Screwed Connections. All threads shall be clean, machine cut, and all pipe shall be reamed before erection. Screwed joints shall be made up with good quality thread compound applied to the male thread only. After having been set up, a joint must not be backed off unless the joint is completely broken, the threads cleaned and new compound applied. Teflon tape or teflon compound may be used for steel, polyvinyl chloride, chlorinated polyvinyl chloride and copper threaded connections.

F. Arrangements. Except as otherwise required, changes in direction shall be made using proper fittings, and unless shown otherwise piping shall run parallel and at right angles to walls and floors. Systems shall be arranged with low points and drains to permit complete drainage of the system. Control piping may be arranged with unions or union connections at low points to permit draining. Unions or flanges shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of piping without disturbing main pipe lines or adjacent branch lines.

G. Penetrations. All penetrations in walls, floors and ceilings shall be sealed watertight and/or gastight to the satisfaction of the Engineer.

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

I. Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place.

J. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check proper functioning, and check nuts and bolts for tightness. Repair, valves and other equipment which do not operate easily or are otherwise defective.

K. Set plumb and support valves adequately in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for easy access.

L. Provide valves with extension stems where required for convenience of operation. Provide extension stems for valves installed low to the ground and elsewhere so that operating wrench does not exceed 6 ft. in length.

M. Provide chain wheel operators on all valves 2-in., and larger where handwheel or lever exceeds 6-ft., 6-in. above floor or operating platform. Provide geared operator where required to position chainwheel in vertical position.

N. Chain of chain operators to extend within 3 ft. of operating floor. Provide two S-shaped hooks for each chain to enable chain to be hooked away from personnel traffic.

3.2 Plastic Piping (PVC). The installation of plastic pipe for pressure service shall be strictly in accordance with the manufacturer's technical data and printed instructions and as follows:

A. General. The solvent welding procedure detailed herein applies to all Polyvinyl Chloride (PVC) pressure piping systems including molded fittings and socket type pump and valve connections.

B. Cement. Shall be a grade specifically recommended by the piping manufacturer for the size and schedule of pipe specified.

C. Pipe Preparation.

1. Cutting. Pipe shall be cut in accordance with the recommendations of the pipe manufacturer.

2. Deburring and Beveling. All burrs, chips, filings, and the like shall be removed from both the pipe inside diameter and outside diameter before joining. All pipe ends shall be beveled approximately 1/1 6-inch to 3/32-inch back from the edge at an angle of 10 to 15 degrees.

D. Fitting Preparation. Prior to solvent welding, all fittings and couplings shall be removed from their cartons and exposed for at least one hour to the same temperature conditions as the pipe in order to assure that they are thermally balanced before joining.

E. Cleaning. Pipe and fittings shall be clean of all loose dirt and moisture from the inside diameter and outside diameter of the pipe end and the inside diameter of the fitting. DO NOT ATTEMPT TO SOLVENT WELD WET SURFACES.

F. Priming. Apply primer to the pipe approximately one-half (1/2 of the pipe diameter and in accordance with the manufactures recommendations). Apply primer freely in the socket keeping surface wet and applicator wet and in motion 5 to 15 seconds. Avoid puddling in socket. For checking penetration, you should be able to scratch or scrape a few thousandths of the primed surfaces away. Repeated applications to either or both surfaces may be necessary. Weather conditions do affect priming action. In cold weather more time is required for proper penetration.

G. Solvent Cement Application. Solvent cement application shall be in accordance with the manufactures recommendation with a minimum of two coats. All excess cement shall be cleaned from the surfaces of the pipe and fittings.

H. Joining. Joining of PVC pipe and fitting shall be in accordance with the manufacturer's recommendations and only at the below solvent welding joining temperatures and joint drying times:

1. The actual joining should not be done in atmospheric temperatures below 40˚F or above 90˚F, or when exposed to direct sunlight.

2. Not less than 48 hours of joint drying time shall elapse for all sizes of pipe and drying temperatures before the joint is moved or subjected to any appreciable internal or external pressure.

Note: Joints for plastic pipe shall be solvent welded except flanged or screwed where required. For plastic to steel, cast iron pipe or ductile iron pipe

connections, complete metal pipe assembly first. Use flanged connections and tighten bolts evenly to prevent warping of rigid plastic pipe. A torque wrench may be used for a tight seal on gasket. Joints shall conform to manufacturer's recommendations installation of valves and fittings shall be strictly in accordance with manufacturer's instructions. In making solvent weld connections, the solvent should not be spilled on valves or allowed to run from joints. All completed pipe lines shall remain undisturbed for 48 hours to develop complete strength at all joints.

3.3 STAINLESS STEEL PIPING

A. Cleaning: All equipment, piping, valves, instruments, and accessories shall be cleaned in compliance with the Compressed Gas Association (CGA) Pamphlet G-4.1, “Cleaning Equipment for Oxygen Service”, latest edition. For items cleaned prior to shipment to the construction site, they shall be properly packaged and stored to protect from contamination. Precleaned items shall be provided a final cleaning/purge with all piping and appurtenances installed.

B. Welding

1. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME A: B31.1 for Pressure Piping, and if recommended by piping or fitting manufacturer.

2. Weld Identification: Mark each weld with symbol identifying welder.

3. Pipe End Preparation:

   a. Machine Shaping: Preferred.
   b. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
   c. Beveled Ends for Butt Welding: ASME B16.25.

4. Surfaces:

   a. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
   b. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
   c. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

5. Alignment and Spacing:

   a. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.

b. Root Opening of Joint: As stated in qualified welding procedure.
c. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

6. Climatic Conditions:

a. Do not perform welding if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 32 degrees F.
b. Stainless Steel and Alloy Piping: If the ambient is less than 32 degrees F, local preheating to a temperature warm to the hand is required.

7. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

8. Surface Defects: Chip or grind out those affecting soundness of weld.

9. Weld Passes: As required in welding procedure.

10. Weld Quality: Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in applicable piping code.

3.4 TESTING OF PROCESS PIPING AND VALVES

A. General. All piping and piping systems shall be leak tested by the Contractor in the presence of the Engineer. The Contractor shall provide typed and witnessed test reports for all such tests. All piping and piping systems not complying with the leak test shall be repaired or replaced by the Contractor to the satisfaction of the Engineer and be re-tested all at no additional cost to the Owner.

1. After the pipelines have been completed and all supports and restraints have been installed, the Contractor shall perform all pressure tests. The Contractor shall be responsible for furnishing all labor, materials, and equipment so that such tests can be accomplished at the time locations necessary.

2. All lines shall be hydrostatically tested for a period of two consecutive hours. The test pressure shall be 150 psi or 2 times the apparent working pressure, whichever is the greater.

3.5 VALVE FIELD TESTING

A. All valves tested in conjunction with hydrostatic testing of the respective piping.

B. Test all valves' smoothness of operation after installation, and make any necessary adjustments, repairs or replacements.

3.6 SHOP PAINTING

A. Both the inside and outside surfaces of all ferrous materials, equipment, and devices shall be thoroughly cleaned at the shop.

B. All ferrous parts/components, except machine surfaces and others obviously not to be painted, and as otherwise specified hereinbefore (including referenced AWWA Standards), shall be furnished with primer coats of rust inhibitive primer compatible as specified in Division 9 – Finishes. Where applicable, surface preparation and primer coating shall be as specified in Division 9 – Finishes. All machined surfaces subject to corrosion shall be coated with a rust preventer/inhibitor prior to shipment. Contractor shall follow Manufacturer's recommendations for preventing corrosion prior to installation and operation.

3.7 PAINTING

A. As specified in Division 9.

3.8 PIPING IDENTIFICATION

A. Piping shall be stenciled to match existing and otherwise as specified in Division 9.

3.9 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION 11200

SECTION 11307

SUBMERSIBLE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 0 and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY OF WORK

A. The work covered under this Section of the Specifications includes the following:

1. Furnish and install the following submersible pump systems and appurtenances as shown on the Contract Drawings:

   i. One (1) submersible duplex grinder pump system and appurtenances, specifically designed to pump residential wastewater from the Clapboardtree Street Pump Station wet well.

2. The submersible pump system manufacturer shall be responsible for testing all submersible pumps, electric motors, and appurtenances as indicated and specified.

3. Submersible pump system shall be equipped in accordance with the Mechanical and Instrumentation Schedules indicated in the Contract Drawings.

B. Related Sections include the following:

1. Division 0 – Bidding and Contract Requirements

2. Division 1 – General Requirements

3. Division 9 – Finishes

4. Division 11 – Equipment

5. Division 13 – Special Construction

6. Division 16 – Electrical

C. Work included as part of Base Bid:

1. Complete submersible pump system, including submersible pumps, guide rails, mounting brackets, pump cables, monitoring relay modules, and pump appurtenances, are specified under this section.

2. Interior process piping and valves are specified under Section 11200.

3. SCADA programming and integration is specified under Division 13.

4. Motor starters and disconnect switches for new pumps are specified under Division 16.

5. All conduit, raceways, boxes, fittings, convenience receptacles, wire and other related electrical equipment furnished and installed as part of each pump installation shall be in accordance with Division 16 – Electrical requirements and as shown on the Contract Drawings.

1.3 SUBMITTALS

A. Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections and as specified herein:

1. Certified shop and erection drawings.

2. Data regarding pump and motor characteristics and performance:

   i. Provide catalog performance curves of pumping units, showing they meet specified requirements for head, capacity, current, and power.
      (a) For units of same size and type, provide curves for a single unit only.
   ii. Provide catalog performance curves at required speed showing maximum and minimum impeller diameters available.

3. Shop drawing data for accessory items.

4. Templates or certified setting plans, with tolerances, for anchor bolts. Anchor bolts shall be provided by the General Contractor.

5. Manufacturer's literature as needed to supplement certified data.

6. Operating and maintenance instructions and parts lists.

7. Shop Manuals.

8. Bearing temperature operating range for the service conditions specified.

9. Recommend spare parts other than those specified.

10. Field inspection reports.

11. Bearing Life: Certified by the pump manufacturer.

12. Qualifications of field service engineer.

13. Recommendations for short- and long-term storage.

14. Shop painting product data, including color charts.

15. Warranties.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 - Quality Assurance and as specified.

B. To be considered “or equal”, the pump shall be a standard product in regular production by a single pump manufacturer who shall have five years minimum, successful experience in the production of equipment specified herein. The manufacturer shall have also satisfactorily furnished ten units of the type described herein within the last five years.

C. The pump and equipment specified shall be standard equipment and totally suited for the application as detailed herein. The equipment to be furnished shall be satisfactory and safely designed, in accordance with the design parameters as detailed in these contract documents. It shall be constructed for continuous, automatic operation, for extended periods of time.

D. When two or more units of a specific type of equipment are to be provided, they shall be the product of a single manufacturer. Multiple units and their parts shall be identical and interchangeable to the greatest extent possible.

E. All items shall be designed and constructed in full accordance with all applicable state and local codes and regulations. Labor, materials and costs required to meet state codes shall be the responsibility of the Contractor and the equipment supplier.

F. Pump manufacturer must provide the pumps and motors, regardless of manufacturer, as a complete and integrated package to insure proper coordination and compatibility of equipment.

G. Manufacturing and testing shall comply with “Hydraulic Institute Standards for Centrifugal, Rotary & Reciprocating Pumps”.

H. Services of Manufacturer’s Representative as specified herein.

I. For each submersible pump system, provide services of factory-trained Service Engineer, specifically trained on type of equipment specified:

1. Submit qualifications of Service Engineer for approval.

2. Man-day requirements listed exclusive of travel time, and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.

3. Installation: Sufficient time to assist in location of anchor bolts; setting, leveling, alignment, field erection, etc.; coordination of piping, electrical, miscellaneous utility connections, but not less than:

   i. ½ day

4. Start-up: Sufficient time for calibration, testing and start-up, but not less than:

    i. ½ day

5. Instruction: Sufficient time for classroom and/or field operation and maintenance instruction, but not less than:

    i. ½ day
    ii. Instruction shall be scheduled separately from installation checkout and field testing, unless approved by the Engineer.

6. Field Performance Testing: Sufficient time for field performance testing including inspections, functional testing, full system performance testing, and full system demonstration testing, but not less than:

    i. ½ day

7. Credit to the Owner unused service man-days specified above, at the manufacturer's published field service rate plus travel costs.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01610 - Delivery, Storage, and Handling and as specified herein. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

C. Deliver spare parts at same time as pertaining equipment. Deliver to Owner after completion of work.

D. Store and safeguard equipment, material and spare parts.

E. Grease coat all exposed ferrous surface prior to shipping, to prevent corrosion during on site storage.

1.6 COORDINATION

A. Coordinate with trades and other equipment to the fullest extent possible, particularly with respect to concrete structures and insets required.

B. Provide an efficient, well-coordinated arrangement without conflict or sacrifice of design.

C. Instrumentation and electrical installation and testing is specified under Division 13 and 16, respectively.

1.7 OPERATIONS AND MAINTENANCE INSTRUCTION MANUALS

A. Operation and Maintenance Manuals: Submit materials for inclusion in Operating and Maintenance Manuals specified in Division 1.

B. Furnish six (6) complete sets of Operations and Maintenance Instruction Manuals (O&M Manuals) prior to start-up for each pump supplied. Furnish one (1) electronic Adobe PDF searchable version on thumb drive or CD-ROM.

C. O&M Manuals shall be prepared with clear instructions which will enable the Owner's personnel to operate and maintain the pumps and all equipment associated with each pump.

D. The manuals shall be prepared specifically for each installation. General literature from the equipment manufacturer that is not specifically applicable to the operation and maintenance of the installed items shall not be acceptable.

E. The Manuals shall be comprehensive and as a minimum contain:

1. Description and operating instructions for pumping components within the station.

2. Instructions relevant to all modes of equipment operation.

3. Service and trouble-shooting instructions as may be available from select manufacturers of equipment supplied.

4. Procedures for the adjustment of equipment at initial start-up, during routine preventative maintenance, and following replacement or repair.

5. Instructions for testing and calibration of electronic components as may be required to determine proper performance.

6. As-Built Mechanical drawings and dimensional information showing the actual layout and location of pumping equipment components within the structures.

7. Loop and ladder logic diagrams. Refer to Division 13 – Special Construction for additional instrumentation and control operation and maintenance requirements.

8. Names, functional titles, addresses, and phone numbers of technical personnel available for on-going technical support.

9. A complete list of materials furnished.

PART 2 - PRODUCTS

2.1 GENERAL

A. The following describes equipment, materials and services necessary to provide a complete, functional submersible pump system(s). The pump system(s) shall be a complete package that contains:

1. Impeller
2. Wear Rings
3. Volute
4. Shaft
5. Bearings
6. Mechanical seals
7. Cable entry seals
8. Motor
9. Cooling system

B. The drawings and specifications indicate general arrangement and description of what is required, but do not purport to cover all details entering into design and construction of the equipment, controls, and appurtenances. Drawings and specifications are, however, intended to cover furnishing, shop testing, delivering, supervision of installation, certifying and field testing all materials, equipment and appurtenances for the complete pump system as specified herein, whether specifically mentioned in these specifications or not.

C. Submersible Pump Systems Which Require Engineering and Contract Changes: A submersible pump system that is offered with the bid and differs in detail and arrangement from that shown in the Contract Drawings may be rejected. All costs associated with changes in the design and construction of the system are to be borne entirely and unconditionally by the General Contractor.

2.2 MANUFACTURER

A. Pump manufacturer acts as single source for all components. The pump manufacturer shall furnish the pumps, motors, and guide rail systems and shall accept complete product responsibility (pump, motor, guide rail systems).

B. Manufacturer: The following pump manufactures have been approved: Hydromatic, Fairbanks, Aurora, or equal.

C. The Contractor may propose an alternative pump, but any changes to accommodate the alternative shall be at no cost to the Owner.

D. The Contract Drawings are based upon using: Two (2) Hydromatic submersible grinder pumps, model HPGFHX300CC.

2.3 SERVICE CONDITIONS

A. Pump capacities and other pertinent operational data are indicated in the Mechanical Schedule (on the Contract Drawings).

B. The submersible pumps for each pump station will normally operate in submerged wastewater conditions inside a wet well. Pumps will be controlled via motor starters provided under Division 16. Pumps will be suitable for pumping residential wastewater. Pumps will run intermittently based on wet well level. Pumps shall have explosion-proof motors and shall be rated for a Class 1, Division 1 environment.

2.4 PUMP CONSTRUCTION - GENERAL

A. Pump configuration as indicated on the Mechanical Schedule in the Drawings.

B. Design and proportion all parts of pump to have liberal strength, stability, and stiffness, and be especially adapted for the service intended. Provide ample room and facilities for inspection, repair and adjustment.

C. Provide lifting devices on casings as required for ease of handling.

D. Provide ribs or other suitable reinforcing if required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to adequately support the motor.

E. Face and drill flanges of suction and discharge connections in accordance with 125-lb. ANSI Standard unless otherwise specified.

F. Provide components with machined registered concentric shoulder fits to ensure precision alignment.

G. Design bearing frame heavy and rigid so as to resist safely and without distortion, all stresses due to impeller thrust and bearing loads.

H. Design pump bearing frame to support shaft and impeller and to contain stuffing box and bearings.

I. Bearings:

1. Anti-friction type.

2. Each bearing shall be a single deep groove ball bearing.

3. Provide bearings with minimum B-10 life rating of 100,000 hours at specified operating conditions based on latest AFBMA and ANSI Standards.

J. Mechanical Seals:

1. Pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant

reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary ceramic seal ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable.

2. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acing between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

K. Statically and dynamically balance each impeller.

2.5 SUBMERSIBLE PUMPS

A. Type: Submersible, vertical, non-clog, centrifugal, hermetically sealed waterproof pump with capability of handling a 3-inch solid.

B. Casing: Pump components shall be either stainless steel or grey cast iron, ASTM A-48, Class 30B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 300 stainless steel construction. All exterior metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump, refer to additional requirements specified herein. Casing shall be fitted with a wear ring.

C. Impeller:

1. For all submersible pump systems, the impeller(s) shall be of class 30 cast iron, dynamically balanced, semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on a replaceable insert ring. The impeller shall have vanes capable of handling solids, fibrous materials, heavy sludge and other matter found in residential wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of residential wastewater. The impeller shall be capable of momentarily moving axially upwards a distance of 15 mm/0.6 inches to allow larger debris to pass through and immediately return to normal operating position.

2. Statically and dynamically balance impellers prior to assembly, such that vibration of complete pumping unit does not exceed Hydraulic Institute limits.

D. Cutter Blades: The pumps shall be equipped with AISI type 300 stainless steel dual cutters. The cutting action of the second stage shall be perpendicular to the first stage to prevent roping action. The upper cutter rings shall be reversible to provide new cutting edges to double life of cutters. The use of a single stage cutter design, 3500 RPM or air filled motors is not considered to be an equivalent.

E. O-Rings: All submersible pumps shall be equipped with Buna N Rubber O-rings.

F. Lifting Fixtures and Cable: Each pump shall be equipped with mounting fixtures and a 316 stainless-steel lifting chain of adequate lifting capacity for the pumps specified. The chain length shall be adequate to extend a minimum of 10-feet above the top of the wet well to allow connection to lifting equipment. Terminate upper end of cable with a swag ball end for easy connection to the portable hoist. A stainless-steel hook bolt shall be installed below the top of the wet well within reach of the access hatch for storage of the excess cable.

G. Pump capacities and heads as indicated on the drawings.

H. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft; couplings shall not be acceptable. Pump shaft shall be stainless steel ASTM A479 S43100-7.

I. Bearings: The upper and lower bearings shall be a single row ball bearing. The lower bearing shall be a tow row angular contact ball bearing. Motor bearings shall be permanently grease lubricated.

J. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

K. Cable entry seal shall be designed for a water tight and submersible seal. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

L. Supply submersible cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards.

M. Pump volute shall be single-piece cast iron, non-concentric design with smooth passages large enough to pass a minimum 3 inch diameter solid that may enter the impeller. Minimum inlet and discharge size shall be as specified in the Contract Drawings.

2.6 MOTORS

A. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an oil filled, watertight chamber. The stator windings shall be insulated with moisture resisting Class F insulation rated for 155° C (311°F). The stator shall be heat-shrink fitted into the stainless steel stator housing. The use of

bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of stainless steel. The motor and pump shall be designed and assembled by the same manufacturer.

B. The combined service factor (combined effect of voltage, frequency, and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on staring and no-load characteristics.

C. The power cable shall be sized according to NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater. The power cable shall have a minimum length of 35 feet.

D. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

E. The pump motors shall be explosion-proof motors rated for a Class 1, Division 1 environment.

2.7 GUIDE RAIL SYSTEM

A. The pump manufacturer shall furnish a guide bar system with supports for each submersible pump provided in accordance with the Contract Drawings, Mechanical Schedule, and as specified herein.

B. Each pump shall be furnished with its own guide bar system consisting of a two stainless steel guide bars (2-inch diameter), stainless steel upper guide bar bracket, an intermediate guide bar bracket (wall-mounted or pipe-mounted), and slide away coupling base/discharge elbow.

C. The slide away coupling shall be designed so that when pump is idle, it may be removed for service or inspection and then returned to service without entering the wet well to unbolt or unlock the connection between the pump and piping.

2.8 SPARE PARTS

A. Furnish and deliver to Owner at site, the following spare parts with parts being identical and interchangeable with similar parts installed in work.

1. For each submersible pump supplied:

i. Basic repair kit consisting of mechanical seals, bearings and O-rings.
ii. One replacement impeller.

iii. One set of axial and radial cutters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each submersible pump and related appurtenances according to the manufacturer's printed instructions, as indicated and specified. No portion of the pump shall bear directly on the shelf floor.

B. All equipment shall be field tested in accordance with this Section of the Specifications.

C. Equipment failing to meet specific conditions shall be removed and replaced at no additional cost to the Owner.

D. Install identifying labels permanently to equipment.

E. Energize no equipment except by pump manufacturer’s serviceman, until authorized in writing.

F. Installation conducted in accordance with applicable Hydraulic Institute Standards.

3.2 WARRANTY

A. Each submersible pump system shall be warranted to be free from defects in material and workmanship under normal and proper use and service, and shall cover 100% of the cost of any replacement parts for a period of year after startup and acceptance by the Owner. After this one year period ends, the warranty shall extend for a pro-rated period of five (5) years after startup and acceptance by the Owner. The Contractor shall provide all labor and materials to repair or replace any defective warranted items specified in this section.

B. This warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made under the requirements of the Contract Documents.

C. Warranties: Submit a written warranty, executed by the Manufacturer of the equipment and the Contractor, agreeing to repair or replace components of the equipment that fail in materials or workmanship within the specified warranty period.

3.3 PAINTING AND CORROSION PROTECTION

A. Both the inside and outside surfaces of all ferrous materials, equipment, and devices shall be thoroughly cleaned at the shop.

B. All ferrous parts/components, except machine surfaces and others obviously not to be painted, and as otherwise specified hereinbefore shall be furnished with primer coats of rust inhibitive primer compatible as specified in Division 9 – Finishes. Where applicable, surface preparation and primer coating shall be as specified in Division 9

– Finishes. All machined surfaces subject to corrosion shall be coated with a rust preventer/inhibitor prior to shipment. Contractor shall follow Manufacturer's recommendations for preventing corrosion prior to installation and operation.

3.4 SHOP TEST, START-UP, FIELD PERFORMANCE TESTS AND QUALITY CONTROL

A. The equipment supplier shall shop-test each fully assembled submersible pump system in their factory prior to shipment. The pump system shall be checked for the following: has no mechanical defects, is in proper alignment, is free of overheating of any parts, is free of all objectionable vibration and noise, and is free of overloading of any parts. During the shop test, operating data shall be taken at regular intervals and incorporated in a report. Provide shop test report to Engineer prior to shipping equipment. All tests shall be performed in conformance with the applicable Hydraulic Institute Standards.

B. A certified factory hydrostatic and performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of five points, including shutoff, shall be taken for each test. At least one point of the five shall be taken as near as possible to each specified condition. Results of the performance tests shall be certified by a Registered Professional Engineer and submitted for approval prior to shipment.

C. The Contractor shall have the Submersible Pump Supplier present during field installation. It shall be the Contractor's responsibility to obtain the recommended installation procedures directly from the manufacturer, and comply with same.

D. Contractor shall have the Submersible Pump Supplier provide a factory service representative who has complete knowledge of the operation of the systems, including mechanical, electrical, control, and alarm components as necessary to perform field performance testing and initial start-up to assure and demonstrate the proper performance of all equipment components.

E. Start-up activities shall include the following:

1. All mechanical, instrumentation, and electrical equipment shall be checked to verify it is properly connected. Preliminary run-ins of mechanical equipment shall be done to verify that it is operating properly.

2. All safety equipment shall be installed and operating properly prior to any equipment operation or performance testing.

3. Alarm and access control systems shall be tested to show they are capable of transmitting, annunciating, and controlling all specified alarm conditions and security features.

F. Field performance tests (functional and performance) shall be performed by the Contractor under the instruction of the manufacturer’s field service engineer as

specified in Division 1. All field testing to be witnessed by the Engineer in the field. Detailed test procedures shall be submitted at least fourteen (14) days prior to the Contractor's proposed field testing date(s). The submittal shall include proposed testing dates; the names of all technical representatives who will perform equipment tests; a testing record form supplied by the manufacturer to collect appropriate test data; a list of any/all laboratory testing required; the specific responsibilities of the Contractor and technical service representative to prepare for and execute the test; all electrical, chemical, water and waste disposal requirements for the tests; and, a description of all activities which require coordination or assistance from the Owner.

G. Conduct field inspections and functional performance tests on all individual components as described in Division 1.

H. The successful performance of all systems, equipment and components shall be demonstrated to the satisfaction of the Engineer by completing a full system performance test as described in Division 1.

I. After the successful completion of the full system field performance test, the Contractor shall conduct a full system field demonstration test as described in Division 1.

J. During the field performance tests, operating data shall be taken at regular intervals and incorporated in a report. Provide field test report to Engineer.

K. In the event that a unit fails to pass a test, make all modifications required to place the unit in proper working order. In the event that a unit fails a test a second time (including vibration amplitude allowable maximums), remove the unit and replace with a satisfactory one, at no cost to the Owner.

L. The Contractor shall provide all necessary instrumentation, equipment, devices, and appurtenances, as well as temporary wiring or piping, required to perform field tests. The Contractor shall be responsible for providing potable water for the performance testing of all pumps. Contractor shall provide all hoses, cross-contamination protection, and additional appurtenances as described in Division 1. Coordinate with Engineer/Owner/Water Treatment Plant Contract Operator on discharge location of water.

M. The Contractor shall be fully responsible for the operation and maintenance of the new equipment and systems until the field test has been completed and substantial completion and facility acceptance has been issued.

3.5 CERTIFICATE OF PROPER INSTALLATION

A. On satisfactory completion of installation, start-up, commissioning, testing and training, submit to the Engineer the equipment supplier's certification of the correctness of installation for each piece of equipment. Certification shall state that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design requirements. Submit the original certificates to the Engineer.

3.6 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700 - Contract Closeout.

END OF SECTION 11307

SECTION 11501

PROCESS GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions, Division 0 and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY OF WORK

A. The Work covered under this Section of the Specifications includes furnishing all equipment, components, accessories, materials, and appurtenances, and providing technical assistance for design, installation, and startup for complete process gauges system as shown on the Contract Drawings and as specified herein.

1. The Contractor shall furnish process gauges where shown on the Contract Drawings and as specified herein.

2. The Contractor shall be responsible for delivery and unloading of the process gauges system as noted below.

3. All required labor, materials and equipment shall be included.

B. Related sections includes the following:

1. Division 1 – General Requirements

2. Division 11 – Equipment

1.3 SUBMITTALS

A. The Contractor shall submit shop drawings for all components of the pressure gauges in accordance with Division 1.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – Quality Assurance and as specified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The available manufacturers are:

1. AMETEK, Inc.; U.S. Gauge Div.

2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.

3. Trerice, H. O. Co.

4. WIKA Instrument Corporation.

5. Or Engineer Approved Equal.

2.2 SERVICE CONDITIONS

A. Each component shall be designed for the environmental conditions of the space in which the component is located.

B. Indoor areas will be mechanically ventilated. Temperatures in the equipment areas will be between 50 and 100 degrees F, and relative humidity may be as high as 100 percent. The wet side of the building exhibits a highly corrosive environment due to elevated levels of hydrogen sulfide (H_2S) related to municipal sewage. All components in the wet side (classified area) of the building shall meet Class 1, Division 1 requirements.

2.3 DIRECT MOUNTING, DIAL TYPE PRESSURE GAUGES

A. All pressure gauges shall be of the indicating-dial type in accordance with ASME Designation B40.100.

1. The case shall be of the liquid-filled type, drawn steel or cast aluminum, 4-1/2 inches in diameter.

2. The pressure-element assembly shall be of the Bourdon tube, unless otherwise indicated.

3. The pressure connection shall be brass, NPS 1/4, bottom-outlet type unless the back-outlet type is indicated.

4. The movement shall be mechanical with a link to the pressure element and connection to pointer.

5. The dial shall be satin-faced, non-reflective aluminum with permanently etched scale markings.

6. The pointer shall be red metal.

7. The window shall be glass.

8. The ring shall be metal.

9. The accuracy shall be Grade A, plus or minus one (1) percent of middle half scale.

10. The vacuum-pressure range shall be 30-inches of mercury of vacuum to 15 psig of pressure.

11. The range for fluids under pressure shall be two (2) times the operating pressure.

12. Provide diaphragm seals for liquid piping to prevent the gauge from being clogged or corroded by process materials.

2.4 REMOTE MOUNTING, DIAL TYPE PRESSURE GAUGES

A. All pressure gauges shall be of the indicating-dial type in accordance with ASME Designation B40.100.

1. The case shall be of the liquid-filled type, drawn steel or cast aluminum, 4-1/2 inches in diameter.

2. The pressure-element assembly shall be of the Bourdon tube, unless otherwise indicated.

3. The pressure connection shall be brass, NPS 1/4, bottom-outlet type unless the back-outlet type is indicated.

4. The movement shall be mechanical with a link to the pressure element and connection to pointer.

5. The dial shall be satin-faced, non-reflective aluminum with permanently etched scale markings.

6. The pointer shall be red metal.

7. The window shall be glass.

8. The ring shall be metal.

9. The accuracy shall be Grade A, plus or minus one (1) percent of middle half scale.

10. The vacuum-pressure range shall be 30-inches of mercury of vacuum to 15 psig of pressure.

11. The range for fluids under pressure shall be two (2) times the operating pressure.

12. Provide diaphragm seals for liquid piping to prevent the gauge from being clogged or corroded by process materials.

2.5 PRESSURE-GAUGE FITTINGS

A. The valves shall be NPS ½" or ¼" stainless steel ball valve.

B. The snubbers shall be in accordance with ASME Designation B40.5, NPS ¼" stainless steel with corrosion resistant, porous metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 GAUGE APPLICATIONS

A. The Contractor shall furnish and install pressure gauges at the suction and discharge of each pump.

B. The Contractor shall furnish and install pressure gauges where noted on the Contract Drawings and as specified in other sections.

3.2 INSTALLATION

A. The Contractor shall furnish ball valves and snubber fitting in the piping for each pressure gauge in accordance with the Manufacturer's written instructions, Contract Drawings, and as specified herein.

B. The Contractor shall provide diaphragm seal protection for all wastewater and chemical feed system applications.

3.3 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700 - Contract Closeout.

END OF SECTION 11501