

SECTION 22 00 00 - PLUMBING PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 APPLICABLE PUBLICATIONS

NSF/ANSI 61 --Drinking Water System Components – Health Effects

NSF/ANSI 372 -- Drinking Water System Components – Lead Content

1.3 DESCRIPTION OF WORK:

- A. Work Included: Provide complete operating plumbing piping systems including pipe, tube, fittings, and appurtenances as indicated and in compliance with these Specifications. The Work of this Section shall include, but not be limited to:

1. Securing and installing plumbing services for the building.
2. A complete domestic hot and cold water distribution system. In laboratory facilities, the domestic hot and cold water distribution system shall be distinct from the industrial water distribution system.
3. **[A complete laboratory air and vacuum distribution system.]**
4. **[A complete natural gas distribution system.]**
5. A complete sanitary soil waste and vent system.
6. A complete storm water piping system.
7. Testing of piping and disinfection of potable water systems
8. Miscellaneous plumbing equipment and specialties required for a complete plumbing system as specified.

- B. Plumbing Services: Secure all plumbing services necessary for the project as required or shown on the Contract Drawings, including paying all required fees and charges. Work related to plumbing services maybe shown on Plumbing, Civil, Architectural or other drawings in the Contract Documents. Plumbing services include, but are not limited to:

1. Securing water connection permit from the authority having jurisdiction.
2. Tapping or arranging for tapping of the city main in accordance with the authority having jurisdiction.
3. Extending water service to meter box.
4. Installation of water meter and meter box in accordance with authority having jurisdiction.
5. Extending water service from meter box to building entry.
6. Securing sanitary sewer connection permit from the authority having jurisdiction.
7. Connecting or arranging for the connection of the sanitary lines(s) into the sanitary sewer in accordance with the authority having jurisdiction.
8. Securing storm sewer connection permit from the authority having jurisdiction.
9. Connecting of or arranging for the connection of the storm drain(s) into the storm sewer system in accordance with the authority having jurisdiction.

10. Installing all drainage systems with the proper slope as required by code.
 11. Boring and jacking existing streets, sidewalks, etc., in city right-of-ways as is necessary. (Where this stipulation cannot be met, it shall be the responsibility of the plumbing contractor to secure all necessary permits at his cost to do whatever is required to secure the service from the city or local authority, and make whatever repairs necessary after the service is secured.)
 12. Arranging with the gas company to have the necessary gas service and properly sized gas meter station located where shown on drawings.
 13. Extending gas service from the gas meter station to the building entry.
- C. Coordination: The Division 23 Contractor shall be responsible for coordinating plumbing services and site utility work as shown on the Contract Drawings with the General Contractor to determine what work is included in the scope of the Division 23 Contractor.
- D. Applications: Applications of piping systems include, but are not limited to, the systems as listed below:

<u>SYSTEM</u>	<u>WORKING PRESSURE</u>	<u>OPERATING TEMPERATURES</u>
Domestic Cold Water		
High	350 psig	55°F to 80°F
Medium	300 psig	55°F to 80°F
Low	150 psig	55°F to 80°F
Domestic Hot Water		
High	350 psig	105°F to 110°F
Medium	300 psig	105°F to 110°F
Low	150 psig	105°F to 110°F
Make-Up Water		
High	350 psig	55°F to 80°F
Medium	300 psig	55°F to 80°F
Low	150 psig	55°F to 80°F
Condensate Drainage	--	40°F to 60°F
Sanitary Drainage	--	--
Storm Drainage	--	--
Natural Gas	--	--
[Laboratory Air]	[100 psig]	[--]
[Laboratory Vacuum]	[-25" HG]	[--]
Fuel Oil (Emergency Generator)	125 psig	55°F to 95°F
Pressures		
High Floors [] through []		
Medium Floors [] through []		
Low Floors [] through []		

- E. Basic Materials and Methods: Refer to Section 23 03 00 for additional plumbing piping system requirements.
- F. Valves and Accessories: Refer to Section 22 10 00 for additional plumbing piping system components.
- G. Vibration Isolation: Refer to Section 23 05 48, "Vibration Isolation", for piping system isolation.
- H. Insulation: Refer to Section 23 07 00, "System Insulation", for piping system insulation.

1.4 QUALITY ASSURANCE:

- A. Welding: Qualify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and job site welding of piping work. Make welded joints on the piping system with continuous welds, without backing rings and with pipe ends beveled before welding. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no weld metal shall project inside the pipe. Refer to Section 23 03 00 for additional requirements.
- B. **[UPC Listing: All materials, fixtures or devices used or entering into the construction of the plumbing system shall be listed for UPC or shall conform to Alternate Standards recognized as "equal" by the City Officials having jurisdiction.]**
- C. Cast Iron Pipe Testing: All cast iron waste and vent pipe shall be 100% factory water pressure tested at 50 psig minimum pressure prior to application of the exterior coating. A certified factory test report shall be furnished to the Engineer with the pipe submittal.
- D. Cast Iron Pipe Manufacturers: Cast iron pipe shall be as manufactured by Tyler Pipe or Charlotte Pipe or AB & I and shall bear the CI mark indicating compliance with the CISPI quality assurance and inspection program.
- E. Grooved Systems: To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by Victaulic. Grooving tools shall be of the same manufacturer as the grooved components.

1.5 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets marked to clearly indicate all plumbing piping system materials.
 - 2. Piping fabrication drawings for all main piping runs **[including connections to existing piping]**. Fabrication drawings shall include plan views and suitable elevations and shall include all accessories and equipment.
 - 3. Additional items as required in Section 23 01 00.
 - 4. Grooved joint couplings and fittings shall be shown on drawings and product materials, and be specifically identified with the applicable Victaulic style or series number.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver components in factory-fabricated water resistant packaging, as applicable.
- B. Handle components carefully to avoid damages to components, enclosures, and finish.
- C. Store components in a clean, dry space, and protect from weather.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

- A. General: Provide pipe and tube of type, joint, grade, size, and weight (wall thickness, schedule or class) indicated for each service. Comply with applicable governing regulations and industry standards.
 - 1. Lead Content: Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for Human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372. Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.

2. Steel Pipe: ASTM A53 or ASTM A106 black or hot-dipped galvanized as specified. [Piping shall be domestically manufactured by one of the manufacturers listed in the latest edition of the American Petroleum Institute (API) approved manufacturers listing.]
3. Copper Tube: ASTM B88, Types "K", Type "L", or Type "M" copper water tube as defined by the Copper and Brass Research Association.
4. Ductile Iron Pipe: ANSI A21.51, Class 350 with bell and spigot ends for push-on joints.
5. Cast Iron Soil Pipe: ASTM A74, most current edition.
6. Hubless Cast Iron Soil Pipe: CISPI 301, most current edition.
7. **[Polyvinyl Chloride (PVC) Storm Pipe: Sewer main SDR 41 or SDR 26, ASTM D3034 with bell ends and pre-inserted gasket joints.]**
8. **[Polyvinyl Chloride (PVC) Water Pipe: Class 150, thickwall, AWWA C900 mechanical joint.]**

2.2 PIPE/TUBE FITTINGS:

- A. General: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve, and equipment connections. Where not otherwise indicated, comply with governing regulations, industry standards, and where applicable, with pipe manufacturer's instructions for selections.
 1. Cast Iron Flanged Fittings: ANSI B16.1, Class 125 or Class 250, black or galvanized as specified, including bolting and gasketing.
 2. Cast Iron Threaded Fittings: ANSI B16.4 or ASTM A126, Class 125 or Class 250, black or galvanized as specified.
 3. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150 or Class 300, black or galvanized as specified.
 4. Malleable Iron Threaded Unions: ANSI B16.39, select for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze, or brass), plain or galvanized as specified.
 5. Threaded Pipe Plugs: ANSI B16.14.
 6. Steel Flanges/Fittings: ANSI B16.5, including bolting, gasketing, and butt weld end connections.
 7. Forged Steel Socket-welding and Threaded Fittings: ANSI B16.11, rated to match schedule of connected pipe.
 8. Wrought Steel Butt-welding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.
 9. Cast Iron Drainage Fittings: ANSI B16.22 galvanized, recessed fittings with pitched threaded ends.
 10. Pipe Nipples: Fabricated from same pipe as used for connected pipe, except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1/2". Do not thread nipples full length (no all-thread nipples).
 11. Wrought Copper/Bronze Solder-joint Fittings: ANSI B16.22 suitable for working pressure up to 250 psig.
 12. Hubless Cast Iron Pipe Fittings: CISPI 301, most current edition, and comply with governing regulations.
 13. Cast Iron Soil Pipe Fittings: ASTM A74, most current edition.

14. Compression Gaskets: ASTM C1563 for gasket testing and ASTM C564 for elastomeric compound.
15. Lead/Oakum Joint Materials: Sealite white oakum and pure pig caulking lead.
16. Standard Grooved End Fittings: ASTM A234 forged steel or ASTM A53 fabricated carbon steel, or ASTM A536 ductile iron fittings joined with Victaulic Style 77 or Style 07 couplings and Grade "E" gaskets on steel systems. **[On copper systems, ASTM B-75 alloy C12200 or sand casting B-584-87 alloy CDA 844 (81-3-7-9) with Style 606 coupling.]**
17. Flanged Fittings: Comply with ANSI B16.15 for bolt-hole dimensioning, materials, and flange-thickness.
18. Flange Bolts: Bolts shall be carbon steel ASTM A307 Grade A hexagon head bolts and hexagonal nuts. Where one or both flanges are cast iron, furnish Grade B bolts. Cap screws utilized with flanged butterfly valves shall be ASTM A307 Grade B with hexagon heads.
19. Flange Bolt Thread Lubricant: Lubricant shall be an antiseize compound designed for temperatures up to 1000°F and shall be Crane Anti-Seize Thread Compound or approved equal.
20. Mechanical Joints for Cast Iron and Ductile Iron Pipe: AWWA/ANSI 21.11 with appropriate gaskets, nuts and bolts.
21. **[Polyvinyl Chloride (PVC) Fittings: ASTM D2665, Carlon, Vylon "Z" high strength sewer fittings.]**

B. Miscellaneous Piping Materials/Products:

1. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section II, Part C, for welding materials.
2. Brazing Materials: American Welding Society, AWS A5.B, Classification BCup-5.
3. Gaskets for Flanged Joints: 1/16" thick for all pipe size 10" and smaller and 1/8" thick for all pipe size 12" and larger. Ring-type shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed nonasbestos or equal.
4. Insulating (Dielectric) Unions: Provide dielectric unions at all pipe connections between ferrous and nonferrous piping. Unions shall be "Clearflow" waterway as made by Victaulic, "Delvin" as made by Pipeline Seal and Insulator Company or "EPCO" as made by Epco Sales, Inc. and shall have nylon insulation.
5. Gaskets for Cast Iron Soil Pipe: ASTM C564, neoprene, compression-type.
6. Push-on-joints: ANSI A21.11, rubber compression-type, "Tyton Joint" as manufactured by U.S. Pipe or equal.
7. Hubless Cast Iron Joints: Heavy duty couplings: Clamp all 125, Husky SD4000 or MG.
8. Solder: All solder used for sweating of water **[and laboratory air and vacuum]** piping joints shall be 95/5 tin-antimony or tin-silver. All solder used for sweating of natural gas piping joints shall be phosphorous-free, non-lead bearing silver brazing solder with a melting point in excess of 1000°F.
9. Threadsealing Tape: Threadsealing tape used for plumbing piping applications shall be stretched or nonstretched teflon tape. Threadsealing tape used for natural gas piping applications shall be nonstretched 0.004" thick teflon tape and shall be yellow in color for identification.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

A. General:

1. Industry Practices: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without failure or degradation of service. Install each run with a minimum of joints and couplings, but with adequate and accessible unions or flanged connections to permit disassembly for maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align accurately at connections, within 1/16" misalignment tolerance. Coordinate piping locations with other trades to avoid conflict. Give ductwork preference unless directed otherwise by the Engineer.
 2. Systems: Install piping parallel or perpendicular to lines of building, true to line and grade, and with sufficient hangers to prevent sags between hangers. Provide fittings at changes in direction. Piping in finished areas shall be concealed, except in mechanical rooms. Where pipes of different sizes join, provide reducing elbows, tees, or couplings. Bushings will not be acceptable.
 3. Expansion and Contraction: Install loops, offsets, sizing joints, and expansion joints, as necessary, to avoid strain resulting from expansion and contraction of piping systems on fixtures and equipment.
 - a. Expansion Loops and Offsets: *Provide expansion loops and offsets in piping systems for not less than one inch (1") expansion or contraction per 100' of pipe. Use Victaulic style 75 or 77 flexible type couplings on expansion loops in accordance with the latest Victaulic recommendations for expansion compensation.*
 - b. [Mechanical Grooved Couplings]: *Provide mechanical grooved connections equal to Victaulic style 75 or 77 where indicated on the Drawings and Specifications to reduce vibration at equipment connections. Provide expansion joints in piping systems by mechanical grooved connections where specifically indicated on the Drawings.] Expansion joints shall be of one of the following types:*
 - Packless, gasketed slip-type expansion joint grooved end telescoping body for installation with Victaulic style 07 rigid type couplings, providing axial end movement up to 3". Victaulic style 150 Mover.
 - combination of Victaulic style 77 or 75 flexible type couplings and short nipples joined in tandem for increased expansion. Joined movement and expansion capabilities determined by the number and style of couplings/nipples used in the joint. Victaulic series 155.
 4. Pipe Grading: Install domestic water piping to pitch down in the direction of flow for drainage. Grade storm, soil, and waste piping at 1/4" per foot whenever possible, and not in any case less than 1/8" per foot for pipe sizes 4" and larger, unless shown otherwise on the Drawings. Grade vent piping at 1/4" per foot whenever possible, and not in any case less than 1/8" per foot toward vents. Grade gas piping at a minimum of 1/8" per foot toward condensation traps at connected equipment.
- B. Steel Pipe: Ream steel pipe after cutting and before threading. Thread with clean-cut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make-up. Use John Crane or approved equal teflon thread tape applied only to male threads to make-up joints.
- C. Copper Pipe: Cut copper pipe square and ream to remove burrs. Clean fitting socket and pipe ends with sand cloth, No. 00 cleaning pads or wire brush. No acids shall be used to clean either pipe or fittings or as a flux in sweating joints. The use of drilled T connections is not permitted.
- D. **[PVC Pipe]: Cut PVC pipe square and remove all burrs. Clean fitting and pipe butt prior to installation. Install all PVC piping in accordance with the manufacturer's recommendations.] Underground installation of PVC piping shall be in compliance with ASTM D2321.**
- E. Final Connections to Equipment Furnished by Owner or Under Other Divisions of These Specifications: Where Drawings show equipment to be furnished under other Divisions of these Specifications or by the Owner, such equipment will be delivered to the site, uncrated, assembled, and set in-place under those other Divisions of these Specifications or under the separate contracts. Any

required automatic control valves shall also be provided under those other Divisions of these Specifications or other separate contracts. Make all final connections of chilled water, hot water, condenser water, gas, domestic water, waste, and vent as shown. Provide valves, unions, strainers, check valves, and traps as required for proper operation of systems and equipment. Equipment not shown or noted on the piping drawings shall not be included in the scope of this requirement.

F. Excavation, Installation, and Backfill for Underground Pipe:

1. Layout: Pipes shall be laid and pipe joints made in presence of the Owner's Representative and field measurements, layouts, batter board alignment, grade establishments, and similar locations shall be performed by a Professional Engineer in the employ of the Contractor. The Contractor's engineer shall be on the job during all underground work. A "Bench-Mark" reference for use by the Contractor shall be provided by the Owner.
2. Pipe Grading: Lay and maintain all pipes at required lines and grades during the course of the Work to comply with the Drawings.
3. Trench: Excavate the trench to the depth required. Properly brace and dewater the trench and keep it free of water during installation, testing pipe, and backfilling. No water shall be discharged onto a street or freeway without approval by the Architect. Refer to Section 15100 for additional requirements.
4. Excavation: The trench shall be at least 18" wider than the maximum diameter of the pipe or largest bell and the pipe shall be laid in the center of the trench. The trench shall be excavated to a depth sufficient to provide for pipe cushions or supports as specified with a minimum backfill cover of 30". Trench width may be increased as required and piling left in place until sufficient compacted backfill is in place. Properly sheet and brace all open trenches to render them secure and remove all such sheeting and bracing before completing the backfill. Comply with local regulations or, in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc. The quantity of excavation required to install sheeting and the installation and removal of sheetings and bracings will not be regarded as Extra Work. All costs incurred for this excavation and the installation of sheeting shall be included in the Contract Price. Refer to Section 23 03 00 for additional requirements.
5. Grading: Upon completion of excavation and prior to the laying of the pipe, the trench bottom shall be brought up to the required elevation with a pipe cushion, except where the cushion has been eliminated by the Engineer. Pipe cushions shall be select material deposited in the trench and shall be compacted, leveled off, and shaped to obtain a smooth compacted bed along the laying length of the pipe. Pipe cushion shall be as follows:
 - a. Stable, Firm Semidry Trench: *Piping shall be laid on undisturbed earth, in a constant uniformly sloped trench. Laying space for hubs or mechanical joints shall be hand cut to 6" either side of the joint and stabilized sand poured and wet in to even with the natural earth trench bottom. The leakproof integrity test of the piping system shall be inspected by the Owner's Representative prior to covering the piping. Failure to notify the Owner's Representative for inspection prior to covering the piping will result in the piping being uncovered and the test being performed again. Where the slope of the trench is found to belly down along the line of piping, before joining, the pipe shall be removed from the trench and the belly converted to uniform slope by adding stabilized bank sand, wet down and slightly mounded to the center of the trench. The section of piping will then be "rolled" into place so with support uniform along its entire length. Where the slope of the trench is found to arch up along the line of piping, before joining, the pipe shall be removed from the trench and the arch converted to uniform slope by cutting the arch out. The section of piping will then be reset into place with support uniform along its entire length.*
 - b. Wet Clay - Black Gumbo: *Piping shall be laid in a constant, uniformly sloped trench. After shaping, the trench shall receive 3" minimum clean bedding sand, which shall be uniformly distributed on the trench bottom. Laying space for the hubs or mechanical joints shall then be hand removed and the piping placed on the setting bed with the weight of the piping distributed evenly on the setting bed over its entire length. The leakproof integrity test of the*

piping system shall be inspected by the Owner's Representative prior to covering the piping by the Engineer's agent. Failure to notify the Owner's Representative for inspection prior to covering the piping will result in the piping being uncovered and the test performed again.

- c. Rock: Where rock is encountered, the trench shall be excavated to a minimum of 6" below the pipe elevation and then backfilled with bedding sand to provide a uniform layer for pipe support. Backfill shall be as indicated for Wet Clay - Black Gumbo.
 - d. Special Considerations: Where there are expansive soil conditions on the site, special precautions shall be taken to prevent pushing and breakage of underground piping. Precautions shall be in accordance with local installation techniques and may include carton forms or special pipe bedding.
- 6. Anchors: Cast iron pipes shall have concrete anchors at each change in direction and/or as directed. Any change in direction exceeding 15 degrees shall be anchored. Concrete anchors shall rest against **solid (virgin) ground** with the required area of bearing on pipe and ground to provide suitable anchoring.
 - 7. Backfill: Backfill trenches only after piping has been inspected, tested, and approved by the Architect. Place backfill material in the trench either by hand or approved mechanical methods. The compaction of backfill material shall be accompanied by tamping with hand tools or approved pneumatic tampers, by using vibratory compactors, by puddling, or by any combination of the three. The method of compaction shall be approved and all compaction shall be done to the satisfaction of the Architect. Backfill completely around pipe, including 18" above the pipe, with suitable bank sand, tamped in 4" layers under, around, and over pipe. Water down backfill as required. The remainder of the backfill for pipes shall be select backfill material tamped at intervals of no more than 12" depths, to attain a 95% Proctor Compaction Density. All materials to be used as select material backfill shall be approved by the Architect. If, in the opinion of the Architect, the excavated material does not meet the requirements of select material, the Contractor shall be required to screen the material prior to its use as select material backfill. Material used in the upper portion of the backfill or subgrade shall not contain stone, rock, or other material larger than 6" in its longest dimension. No wood, vegetable matter, or other material, which in the opinion of the Architect is unsuitable, shall be included in the backfill. The upper 24" of backfill may be water jetted, if desired. Bring backfill up to finish grade identified on the Architectural Drawings, including additional backfill required to offset settlement during consolidation. When removal of unsuitable, excavated material creates a shortage of backfill material, the Contractor shall, at no change in Contract amount, furnish material as specified in this Section in the amount required to complete the backfill.
 - 8. Existing Surfaces: Restore existing streets, driveways, and sidewalks damaged during the excavation work to acceptable condition, subject to approval by the Architect.
 - 9. Safety: Provide street and sidewalk excavations with approved barricades, warning lights, and cover plates as required by the City. Refer to Section 23 03 00 and Division 1 for additional requirements.

G. Pipe Fabrication Drawings:

- 1. Pipe fabrication drawings shall be submitted for all piping in the Central Plant, **[Utility Tunnel,]** Mechanical Rooms, Penthouse and for Equipment connections and all other areas requiring coordination with other trades.
- 2. Pipe fabrication drawings shall be double line drawings to scale on 1/4" scale building floor plans and shall indicate pipe size, fittings, valves, accessories, connections, system type, insulation, support requirements, pipe elevations and other information required for coordination with other trades and fabrication of pipings.
- 3. Pipe fabrication drawings shall be coordinated with other trades and building construction prior to submittal for approval. Refer to Section 23 01 00 for additional shop drawing requirements.

- H. Basic Materials and Methods: Refer to Section 23 03 00 for additional requirements related to plumbing piping.

3.2 PLUMBING SERVICES:

- A. General: Install the various piping systems as described and as required by the local plumbing inspection department.
1. Slope domestic hot and cold water **[and laboratory air and vacuum]** piping to drain and provide with hose valves (drain valves) at low points. **[Branch taps for laboratory air and vacuum piping shall be made from the top of the piping main.]**
 2. Install soil, waste, and vent piping with horizontal lines pitched in accordance with local codes, but in no case less than 1/4" per foot for pipe 3" and smaller and 1/8" per foot for pipe 4" and larger. Install soil, waste, and vent piping with hubs of each length of piping in the upstream position.
 3. Make-up lead and oakum joints with molten lead run into hubs in one continuous pour, to a minimum depth of one inch (1").
 4. Make-up "Ty-Seal" or "Dual-Tite" gasketed joints using lubrication and joining tools as instructed by the manufacturers. Base of stacks, horizontal runs under pressure, and gasketed pipe 5" and larger shall be made up using "Tyler Lubrifast" joining material. Horizontal joints, 5" and larger, shall be restrained.
 5. Torque "No-Hub" joints in accordance with manufacturer's instructions. Do not install "No-Hub" joints below ground.
 6. Provide chrome-plated piping at each fixture installed in a finished space. Install with proper strap wrenches to avoid marking or defacing.
 7. Provide proper restraints on riser and stack offsets.
 8. **[Kitchen equipment shall be furnished under another Division of the Specifications. This Contractor shall install all faucets, drains, hose outlets, and similar items supplied by kitchen equipment Contractor. This Contractor shall furnish and install traps, trim, stops, and similar connections as required to make piping system complete in every way. All exposed piping to sinks, disposals, hose reels, and similar items shall be chrome-plated. Gas piping to kitchen equipment shall be black steel pipe.]**
- B. Plumbing Connections to Mechanical Equipment:

[VERIFY THE FOLLOWING]

1. General: Provide necessary pipe and fittings. Make final connections to provide cold water make-up and natural gas supply to mechanical equipment. Locate cold water make-up and gas supply where shown and connect with suitable stop valves, check valves and bypass valves as applicable.
2. Gas Supply: Provide gas supply to boilers and kitchen equipment as indicated on Drawings.

3.3 MAKE-UP WATER PIPING SYSTEMS:

- A. Connections: Connect domestic water to automatic fill and manual quick-fill connections on each HVAC piping system and as shown on Drawings. Provide reduced pressure backflow preventers at each system.
- B. Compatibility: Use piping and fittings of same material type as materials of the domestic water supply.

3.4 DOMESTIC HOT AND COLD WATER PIPING SYSTEMS:

- A. Interior Hot and Cold Water Piping:
1. Piping 3" and smaller, Type "L" copper tubing hard drawn joined using non-lead bearing solder, such as 95-5 silver or antimony solder (95% tin and 5% silver or antimony). **[or grooved ends**

with Victaulic Style 606/607 couplings {flaring of tube and fitting ends to IPS dimensions is not permitted}}.

2. Piping 4" and larger, Schedule 40, galvanized steel pipe, ASTM A53 with galvanized malleable iron fittings, or galvanized cast iron flanged fittings.
3. Provide isolation fitting whenever dissimilar materials are used.
4. **[Option: At the Contractor's option, for galvanized steel piping 4" and larger, a grooved piping connection system with "cut-grooves" may be used. Grooved couplings shall be Victaulic Style 75 or 77 flexible type with Grade "E" synthetic rubber gaskets. Rigid couplings shall be used at valves and in other areas where piping system rigidity is required and shall be Victaulic Style 07 Zero-Flex couplings with Grade "E" gaskets syntahetic rubber gaskets. Taps to mains shall be made using Victaulic Style 72 or Style 920/920N hot dip galvanized outlet couplings or fittings or Gruvlok Fig. 7045/7046 hot dip galvanized outlet couplings or fittings. Mechanical "T" couplings with U-bolts shall not be permitted. Flange connections shall be made using Victaulic Style 741 or 743 flanges with Grade "E" synthetic rubber gaskets. Fittings for elbows, tees, reducers, etc. shall be Victaulic or Gruvlok hot dip galvanized full flow fittings. All grooved piping connection materials shall be utilized with the manufacturer's recommended groove cutting tool. All grooved piping couplings and fittings used in association with an individual coupling or fitting shall be by the same manufacturer. The use of boltless couplings, reducing couplings and Mechanical "T" fittings with U-bolts is prohibited. All wetted surfaces in the piping system shall be hot dip galvanized and all proposed grooved piping connection materials shall be suitable for domestic water use at the temperatures and pressures at the point of application. Painted couplings may be used where they meet the above requirements. Grooved reducing couplings shall not be installed.]**

- B. Piping Runouts to Fixtures: Provide piping runouts to fixtures sized to comply with governing regulations. Where not otherwise indicated, provide runouts sized to comply with the following: lavatories - 1/2" hot, 1/2" cold; water closet flush valves - one and one half inch (1-1/2") cold; urinal flush valves - one inch (1") cold; drinking fountains - 1/2" cold. Provide each fixture with a shut-off valve for each supply line. All exposed lines shall be chromium-plated.
- C. Air Chambers:
1. Riser Air Chambers: At the top of each main hot and cold water riser, provide [a properly sized Wade Shoktrol or approved equal sealed air chamber] [an air chamber two pipe sizes larger than riser pipe and 24" high].
 2. Fixture Air Chambers: At each hot and cold water supply pipe at each fixture, provide [a properly sized Wade Shoktrol or approved equal sealed air chamber] [an air chamber the same size as the fixture branch and not less than 18" high].

3.5 UNDERGROUND DOMESTIC WATER AND FIRE PROTECTION PIPING:

- A. Service Piping Two Inches and Smaller: Type "K", copper tubing with wrought copper brazed end fittings.
- B. Service Piping Three Inches and Larger: Class A, 150 AWWA ductile iron bell and spigot, push-on joint, pressure water pipe. Joints shall be of the push-on-type employing a molded rubber "O" ring gasket retained in a ring recessed into the inside of the bell **[per ANSI A21.1] [Class 150 cast iron domestic water pipe with mechanical joints.] [Class 150 mechanical joint PVC]. [All underground cast iron or ductile iron pipe shall be encased in black 8-mil thick, polyethylene plastic sheet, per ANSI/ AWWA, C105/A21.5-82, Method C.] [Pipe and joints shall be manufactured by Tyler Pipe and Foundry Company or equal. Coat pipe and fittings inside and outside with the manufacturer's standard coal tar enamel suitable for domestic water service.]**
- C. Underslab Piping: Piping under the building slab for hose bibbs and equipment stubs shall be no larger than one inch (1") and shall be Type "K" soft drawn copper tubing. Piping shall be run continuous from slab penetration to penetration and there shall not be any fittings or connections

below the slab. Piping shall have minimum 12" cover in nonpaved areas. Underground piping up to 3" above slab penetrations shall be protected as described herein below.

- D. Underground Pipe Protection: Underground metallic water piping which is not coated with coal tar enamel shall be coated with 3M Scotchwrap Pipe Wrap Insulation No. 50, applied in strict accordance with the manufacturer's recommendations. Machine wrapping of piping is acceptable. Concrete thrust blocks shall be poured at all turns and offsets of mechanical joint piping.

E. **[Water service piping shall not be installed under concrete slabs on grade.]**

3.6 STORM AND SANITARY DRAINAGE SYSTEM:

- A. Waste and Vent Piping Underground: All underground waste and vent piping, including turns to the vertical to 12" above the grade floor slab, shall be constructed of service weight (SV) hub and spigot cast iron soil pipe and fittings with **positive sealing elastomeric gasket joints.** **Elastomeric gaskets shall be installed using an approved gasket lubricant.** Pour concrete thrust blocks at all below grade turns and offsets for waste piping 6" and larger.
- B. **[Vertical] Waste [and Vent] [Stacks] [and Waste] [Piping] Above Grade**: Service weight (SV) cast iron pipe and fittings with positive sealing neoprene elastomeric compression type gasket joints. Elastomeric gaskets shall be installed using gasket lubricant. All horizontal stack offsets **[and elbows]** (4" and larger) shall be joint-strapped and supported using riser clamps and threaded rod.
- C. **[Horizontal Fixture, Waste and] Vent [Manifolds] [Piping] Above Grade**: Connect to the vertical stack with "No-Hub" cast iron soil pipe and fittings assembled with Stainless Steel No-Hub Coupling Assemblies.
- D. Building Storm Drainage Piping Underground: All underground horizontal Storm Water piping including turns to the vertical to 12" above the grade floor slab, shall be constructed of service weight (SV) hub and spigot cast iron soil pipe and fittings with **[positive sealing neoprene gasket] joints.** **[Elastomeric gaskets shall be installed using an approved gasket lubricant.]** Pour concrete thrust blocks at all below grade turns and offsets. The Building Storm Water System shall extend **[5'-0"]** outside the Building **[to a catch basin as shown on the Drawings]**.
- E. Building Storm Piping Above Grade: All Storm Drainage piping within the Building shall be service weight (SV) cast iron pipe and fittings with positive sealing neoprene elastomeric gasket joints. Elastomeric gaskets shall be installed using an approved gasket lubricant. All horizontal stack offsets **[and all elbows]** shall be joint-strapped and supported using riser clamps and threaded rod.
- F. Insulation: All **[kitchen grease waste,]** condensate drains and related piping, roof drain[,], and overflow roof drain bodies and horizontal runs of storm drainage piping within the occupied spaces of the building, shall be insulated as specified in Section 23 07 00.
- G. Parking Garage Storm Drain Piping Underground: All underground Storm Water piping including turns to the vertical to 12" above the grade floor slab shall be constructed of **[service weight (SV) hub and spigot cast iron soil pipe and fittings with positive sealing neoprene elastomeric gasket joints.] [PVC SDR-41 pipe and solvent welded fittings.] [Elastomeric gaskets shall be installed using an approved gasket lubricant.]** Pour concrete thrust blocks as all below grade turns and offsets. The Garage Storm Water System shall extend **[5'-0"]** outside the Garage **[to a catch basin as shown on the Drawings]**. **[All parking garage drainage shall route through an oil interceptor prior to discharge.]**
- H. Parking Garage Storm Drain Piping Above Grade: All Storm Drainage piping within the Parking Garage shall be **[service weight (SV) cast iron pipe and fittings with elastomeric neoprene gasketed joints.] [PVC SDR-35 (ASTM D2241) pipe and solvent welded fittings (ASTM D2466, D2564). All PVC shall be supported at each floor level.] [Elastomeric gaskets shall be installed using an approved gasket lubricant.]** All horizontal stack offsets **[and all elbows]** shall be joint-strapped and supported by riser clamps and threaded rod.
- I. Pump Discharge Piping: Discharge from pumps to the horizontal gravity main shall be Schedule 40 galvanized steel with galvanized cast iron drainage fittings. Each pump discharge shall be carried

separately to the horizontal gravity main and shall discharge into the top of the horizontal gravity main with a wye fitting.

J. Cleanouts:

1. Locations:

- a. *At base of every drainage stack.*
- b. *Upper terminal of each horizontal drainage pipe.*
- c. *Each 90' length of horizontal straight run of drainage piping on the exterior, each 50' length of horizontal straight run of drainage piping in the interior.*
- d. *Where shown on Drawings.*
- e. *As required by local code.*

2. Size: Cleanouts shall be line size for piping up to 4" and 4" size for piping larger than 4".

3. Access: Provide access doors for access to cleanouts installed in concealed locations.

K. Fixture Connections:

1. Water Closets: Galvanized castable nipples.
2. Urinals: Copper or cast iron nipples with suitable adapters.
3. Lavatories: Copper or cast iron nipples with suitable adapters.
4. Service Sinks: Brass or cast iron nipples with suitable adapters.
5. Drinking Fountains: Copper or cast iron nipples with suitable adapters.

L. Grease Traps and Sampling Wells: Furnish and install grease traps and sampling wells as shown on the drawings and required by local authorities. Grease traps and sampling wells may be precast or cast-in-place concrete. Coordinate forming and pouring or purchase and setting of grease traps with the General Contractor.

3.7 NATURAL GAS PIPING SYSTEM:

- A. Code Compliance Products: Comply with local utility company and AGA regulations which require the products used for gas piping work to be selected from lists in certain published standards or coded as indicated.
- B. Gas Piping: Gas piping intended for operation at pressures of 5 psig or greater shall be ASTM A53, Schedule 40, black steel joined by Schedule 40, black welding fittings. Gas piping, 2-1/2" and smaller, intended for operation at pressures less than 5 psig shall be ASTM A53, Schedule 40, black steel joined by Class 150 socket weld fittings except that Class 150, banded, black malleable iron, threaded fittings may be used at valves and equipment connection **[and downstream of room isolation valves]**. Gas piping, 3" pipe size and larger, intended for operation at pressures less than 5 psig shall be ASTM A53, Schedule 40, black steel joined by Schedule 40, black welding fittings. Provide condensation traps with removable caps at all equipment connections.
- C. Concealed Piping and Protection: Gas piping run concealed in walls, chases, or above ceilings shall be installed in a Schedule 20 welded steel sleeve vented to the outside atmosphere. Suitable internal spacers shall be provided. Inaccessible piping shall be all-welded connections. Socket type weld fittings may be used for sleeved gas piping.
- D. Underground Piping: Gas piping installed below grade shall be coated with Republic Steel Corporation (US) "X-Tru-Coat" high density polyethylene extruded coating, factory-applied with a fluid mastic to a minimum thickness of 0.040". Field welds, joints, and fittings shall be protected with mastic undercoat and by wrapping at least two layers of "X-Tru-Tape" installed as instructed by manufacturer.

- E. Gas Distribution System Drip Pipes: Drip pipes shall be provided throughout the gas piping systems for the purpose of accumulating moisture and condensate. They shall be sized no smaller than the gas main which they drain in each instance.
- F. Gas Distribution System Fabrication Methods:
1. All interior gas piping shall, wherever possible, be installed so as to grade back toward the gas entry. In all cases where such grading is impracticable and it is necessary to grade the house piping away from the inlet, drip pipes of adequate capacity must be installed where traps are formed by such changes in grade. Drip pipes shall terminate a screwed pattern, malleable iron black cap. No drip pipes shall be used as outlets for the attachment of any fixture or gas appliance. Drip pipes must, moreover, be placed at the bottom of all vertical pipes which rise from and connect to the end of any horizontal pipe.
 2. All branch outlet pipes shall be taken from the top or sides of running horizontal lines and not from the bottom. No crosses shall be installed in any horizontal gas line. No unions, gas cocks, or valves shall be used in any concealed location. Every gas cock and valve shall be accessible for inspection and repair.
 3. The general arrangement of all gas piping shall be such that the number of threaded joints involved is reduced to an absolute minimum. If obstructions are encountered, pipe shall not be bent to circumvent such obstructions. Welding fittings shall be used for this purpose in the case of welded lines, and if threaded lines are involved, screwed fittings shall be used. Wherever gas pipes run through outside brick, stone, or other walls, the opening around the pipe shall be securely and rigidly sealed. Gas pipe sizes shall be at least one pipe size larger than the inlet of the gas appliance which they supply. No bushings shall be used in conjunction with any gas piping.
- G. Gas Distribution System Protective Coating: Gas piping systems installed underground shall utilize pipe which has been factory coated with Scotchkote protective resin No. 212. All materials, surface preparation, application and testing shall conform to Federal Specification L-C-530 B-Type 2. This coating shall be applied by A&A Coating Company, Lone Star, Texas. Underground welded joints and fittings shall be coated with Scotchkote No. 306 epoxy resin and taped with vinyl Scotchwrap-50 brand tape. Flanged joints shall be given two coats of Koppers Company No. 300M Catalyzed Coal Tar Epoxy. Under no circumstances shall any backfilling operations be begun until these pipe protection operations have been completed.

3.8 **[LABORATORY AIR AND VACUUM PIPING SYSTEM:**

- A. Pipe and Fittings: Piping 4" and smaller shall be Type "L" copper tubing hard drawn with wrought copper brazed end fittings.
- a. *Victaulic grooved end copper fittings shall be wrought copper conforming to ASME B16.22, or bronze sand castings conforming to ASME B16.18, manufactured to copper tubing dimensions with grooves designed to accept Victaulic Style 606/6-7 couplings. Grade "E" EPDM synthetic rubber gasket for oil-free air, or grade "T" Nitrile for air with oil vapors, FlushSeal design. (Flaring of tube and fittings ends to IPS dimensions is not permitted).*
- B. Cleaning: All piping and fitting shall be washed and sealed prior to installation and shall be blown out with compressed air before service fittings are installed.]

3.9 CONDENSATE DRAINAGE:

- A. General: Provide a condensate drain pipe to connect each cooling unit drain pan and secondary drain pan to extend to and discharge into an open-type drain in the plumbing system.
- B. Assembly: Use Schedule 40, galvanized steel pipe made up with Class 125, galvanized, threaded fittings. Assemble fittings to form a trap with depth equal to or greater than operating pressure of the unit served. Drains shall be of the sizes indicated, but not less than the full size of the drain pan connection. Air handling unit drains shall have deep seal traps to permit unit pan drainage. Install a deep seal trap for each blow-through or draw-through air handling unit to maintain the water seal.

3.10 CHASE AND WALL PIPING SUPPORTS:

- A. All piping whether sanitary or water shall be rigidly installed in all chases or walls. Test for rigidity shall be that the piping is virtually immovable by hand short of deforming the piping. Valve, stop and fixture penetrations thru chase or fixture mounting walls shall be firmly supported from just inside the wall or chase prior to penetration to the room-side of the chase or wall.
- B. Support inside the chase or wall for Sanitary Waste and Vent Piping shall be accomplished by utilizing fixture carrier bolt-downs, "Uni-Strut" or similar structural bracing system, "U-bolts", nuts and lock-washers, all bolted to the floor and to the piping system.
- C. Support for Water Piping or other similar service piping shall be accomplished by using a "system" designed for that purpose. An approved system shall consist of preformed steel supports which shall be installed between studs or joists and preformed nonmetallic pipe holder inserts which are designed to rigidly support or hold the piping to the steel supports.
- D. In no case shall Sanitary Sewer Waste or Vent Piping depend on blocks, brick, stone or wood sleepers for its final support. In no case shall Water Piping or similar service piping depend on its final support on "tie-wires", soldering or brazing to metal studs or joists, copper tube soldered to risers and tied to joists or any other method which does not have the written approval of the Engineer. Piping improperly supported shall have improper supports promptly removed and replaced with specified supports at the direction of the Engineer at no additional cost to the Owner and/or Architect/Engineer.
- E. Support system shall be as manufactured by "Holdrite" or an approved equal.

3.11 CLEANING, FLUSHING, TESTING AND INSPECTING:

- A. Cleaning: Clean exterior surfaces of installed piping systems and prepare surface for application of any required coatings.
- B. Piping Tests:
 - 1. General: Blank off equipment during tests. Perform tests before piping is enclosed in walls, floors, partitions or in any other way concealed from view. Tests may be performed in sections. Tests shall be witnessed by the Engineer or Owner's Representative and local inspectors and results presented to the Engineer for acceptance and approval prior to concealing piping from view. Provide all necessary equipment for testing, including pumps and gauges. Refer to Section 15020 for additional requirements.
 - 2. Domestic Water Systems: Test hot and cold water systems hydrostatically to a pressure of 150 psig or 1-1/2 times working pressure, whichever is greater, for a period of 24 hours. Repair all leaks, replacing materials as necessary, and repeat tests until systems are proven tight.
 - 3. Soil, Waste and Vent Piping System: Test soil, waste, and vent piping by plugging all openings and filling system to height required by UH Plumbing Inspector, but not less than 10' above the level of the pipe being tested, for a minimum of 3 hours. Inspect all joints for leaks, repair all leaks found, and retest until piping is demonstrated to be free from leaks as evidenced by no perceptible lowering of the water level after 3 hours. In addition to water test, apply peppermint or smoke tests, if required by local code.
 - 4. Storm Drainage Piping System: Test storm drainage piping same as specified for Soil, Waste, and Vent Piping System.
 - 5. Sump Pump and Sewage Ejector Discharge Piping: Test sump pump and sewage ejector piping same as specified for domestic water systems.
 - 6. Natural Gas Piping System: Test natural gas piping with compressed air or nitrogen to a pressure of five times the expected service pressure, but not less than 100 psig, for a period of 24 hours. Repair all leaks, replacing materials as necessary, and repeat test until systems are proven absolutely tight. After all pneumatic testing of the entire gas piping system has been completed and all leaks have been repaired and at a time deemed suitable by the Owner's duly authorized representative, the Contractor shall have the gas supply turned on and the gas

odorant chemical added by a representative of the gas company, as applicable. The Contractor shall then bleed gas from every riser and every runout until the odor of gas is present at every gas connection.

7. Flushing: Flush water piping systems with clean water following successful testing. Refer to Section 15100 for additional pipe cleaning and flushing requirements.
8. **[Laboratory Air and Vacuum Piping Systems: Test laboratory air vacuum piping with compressed air or nitrogen at a pressure of 150 psi for a period of 24 hours. Repair all leaks, replacing materials as necessary, and repeat tests until systems have been proven tight.]**

- C. Disinfection of Potable Water Systems: Disinfect all underground and above ground potable water lines for new construction projects and major renovation projects to ensure compliance with the methods and procedures outlined in ANSI/AWWA Standard C651 and meet the bacteriological standards. Underground potable water lines shall be considered those potable water lines downstream from the water meter; above ground water lines shall be considered those potable water lines upstream from the water meter.

Contractor is responsible for demonstrating a thorough laboratory testing and analysis of the potable water system to meet EPA Primary and EPA LCR compliance standards.

1. Reference Standards and External Information:
 - a. *ANSI/AWWA Standard C651 - The Water Main Disinfection Standard*
 - b. *A Compilation of Water Quality Goals, 17th Edition, January 2016:*
http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/docs/wq_goals_t_ext.pdf (California)
2. Responsibilities
 - a. *The plumbing contractor will provide the personnel, equipment and materials necessary to perform the actual disinfection of the underground lines in compliance with ANSI/AWWA Standard C651.*
 - b. *When a sub-contractor performs the disinfection procedure, it is the joint responsibility of both the general contractor and designated sub-contractor to comply with this procedure.*
 - c. *Environmental Health and Safety (EHLS) is responsible for performing all analytical tests and verifying that the building's plumbing system meets the minimum bacteriological standards as set forth by the Texas Department of Health and Safety Code.*
 - d. *EHLS inspector/s will verify the chlorine residual at the end of the retention time and issue a flush order.*
 - e. *Facilities Planning and Construction (FPC) is responsible for overseeing the entire disinfection procedure including verification of the chlorine residual.*
3. Standard Disinfection Procedure for all Underground Potable Water Lines
 - a. *EHLS strongly prefers the use of the slug method (calcium hypochlorite tablets placed in each section of water lines as the lines are installed) in disinfecting potable water systems. EHLS also requires that the initial Chlorine Residual shall be at least 100 ppm (100 mg/L).*
 - b. *Tablet or Continuous feed methods require prior approval by EHLS prior to the installation of the underground piping.*
 - c. *Alternative forms of chlorine that may be used in the disinfection operations (with EHLS approval prior to lines being installed) include liquid chlorine, sodium hypochlorite solution or granules or tablets.*
 - d. *EHLS inspector/s will verify the chlorine residual at the end of the retention time and issue a flush order.*

- e. *The entire system shall be continuously flushed with clear potable water. The flush water shall be directed into a sanitary sewer system in accordance with the municipal separate storm water sewer system (MS4) adopted by the University of Houston (<http://www.uh.edu/ehls/environmental/water>). Alternative methods of collection of the flush water can be utilized with prior approval from EHLS.*
 - f. *The chlorine residual in the effluent shall be monitored on a periodic basis. When the chlorine residual is equal to the chlorine residual in the distribution system, the system has been properly flushed. The FPC inspector will then contact EHLS to arrange for bacteriological testing.*
4. Emergency Slug Method:
 - a. *In cases of emergency when the system must be returned to service as soon as possible, a chlorine residual of 325 ppm with a contact time of only 15 minutes may be used with prior approval from EHLS (Sec. 10.4 of Std. C651-92). The affected section can be flushed and returned to service if the chlorine residual is not less than 300 ppm when the emergency methods were employed.*
 - b. *EHLS will sample the system to ensure the water meets minimum bacteriological standards after the system has been placed back into service.*
5. Bacteriological Analysis of the Underground Potable Water Lines
 - a. *EHLS will sample the water system effluent from the sample cock (the end of the distribution line used for water sampling). The Total Coliform Count Method, as summarized in "Standard Methods for the Examination of Water and Wastewater" A.P.H.A. American Public Health Association, will be used to verify the bacteriological water quality.*
 - b. *When all samples demonstrate that the water system meets the minimum standards, EHLS will sign off on the disinfection procedure.*
 - c. *The minimum standards are:*
 - *Total Coliform Count (CFU/ml -- Coliform Forming Units per milliliter of water) = Zero.*
 - *Heterotrophic Plate Count = 500 CFU/ml or less.*
6. Chlorination Procedure for the Above Ground Potable Water Lines:
 - a. *The FPC/EHLS inspector will verify ALL underground distribution lines (upstream from the meter) have been properly disinfected.*
 - b. *The entire building distribution system shall be continuously flushed with clear potable water. When complete, the contractor will then notify the FPC/EHLS inspector.*
 - c. *The FPC/EHLS inspector will contact EHLS to arrange for bacteriological testing of the new system.*
7. Bacteriological Analysis for the Above Ground Potable Water Lines:
 - a. *FPC/EHLS will sample the water system effluent from the sample cock. The Total Coliform Count Method, as summarized in "Standard Methods for the Examination of Water and Wastewater", A.P.H.A. will be used to verify the bacteriological water quality.*
 - b. *FPC/EHLS will also conduct a Heterotrophic Plate Count of water samples from the safety showers and eyewash stations. Ensure the drinking fountains, safety shower and eyewash stations have been thoroughly flushed.*
 - c. *When all samples demonstrate that the water system meets the minimum standards, EHLS will sign off on the disinfection procedure.*
 - d. *The minimum standards are*
 - *Total Coliform Count (CFU/ml -- Coliform Forming Units per milliliter of water) =Zero.*

- Heterotrophic Plate Count = 500 CFU/ml or less.

8. Reporting Requirements:

- a. *The general contractor will notify EHLS of all scheduled building chlorination procedures at least two days prior to disinfecting the potable water system. The general contractor will notify EHLS of all scheduled building chlorination procedures at least two days prior to disinfecting the potable water system. In situations where the building is partially occupied, the slug procedure requires notification to anyone in the building performing operations involving eye wash or safety showers that operations must stop during this period: water would not be considered safe for these uses unless the chlorination operation can be isolated.*

9. Competency Assessment and Training Requirements:

Not applicable.

- D. Cleaning and Adjusting: Thoroughly clean and disinfect all plumbing fixtures, including all exposed trim. Adjust all flush valves for proper flushing, but without excess use of water. Demonstrate to the Engineer that the entire plumbing system and all its components are functioning properly.
- E. Inspecting: Visually inspect each run of each system for completion of joints, adequate hangers, supports, and inclusion of accessories and appurtenances.
- F. Grooved Piping Installation: Grooved joint piping systems shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. All grooved couplings, fittings, valves and specialties shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by Victaulic. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.12 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 00 00

SECTION 22 05 00

ACID RESISTANT WASTE/VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 SCOPE OF WORK:

- A. Work Included: Provide all labor, materials, equipment, tools and services, and perform all operations required in connection with or properly incidental to the construction of complete acid waste and vent system as indicated on the Drawings, and as required for a complete and functional system.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: Provide products complying with these specifications and produced by one of the following:
 - 1. PVDF Pipe and Fittings:
 - a. GSR Sloan.
 - b. Orion

1.4 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets of acid waste/vent pipe, fittings and other required accessories clearly indicating all features, options, materials and dimensions.
 - 2. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver acid resistant waste/vent piping system components in factory-fabricated water-resistant wrapping.
- B. Handle acid resistant waste/vent piping system components carefully to avoid damage to material component, enclosure and finish.
- C. Store acid resistant waste/vent piping system components in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 ACID WASTE AND VENT PIPE AND FITTINGS:

- A. Above ground pipe and fittings located within spaces utilized as air plenums shall be IAPMO listed, Schedule 40, FR-PVDF manufactured from Kynar 740-02, flame retardant Polyvinylidene Fluoride (PVDF) conforming to ASTM F 1673, with a limiting oxygen index (LOI) of 60, Resin must have a vertical burn rating of 94 V-0. Kynar 740-02 resin based on testing to ASTM E84 (UL 723) must have surface burning characteristics greater than or equal to a flame spread 5 and smoke development 35. Fittings shall be third party certified to ASTM F 1673 and ASTM E84, and IAPMO approved, with a tapered elastic retaining ring designed to lock into a machined groove on the

mating piping. All fittings shall have integrally molded union connections. No metallic grab rings or clamps shall be allowed.

- B. Polyvinylidene Fluoride pipe and fittings shall be as manufactured by IPEX, "Plenumline", or approved equivalent.

2.2 HANGERS AND SUPPORTS:

- A. Horizontal Piping: All horizontal piping shall be supported on clevis type hangers.
- B. Vertical/Riser Piping: All vertical/riser piping shall be supported using riser clamps padded with 1/4" thick solid neoprene or Buna-N rubber.
- C. Wall Chase Piping: All wall chase piping shall be supported using the wall/chase support system specified in Section 22 00 00.

3.1 INSTALLATION:

- A. General: All piping, fittings and accessories shall be installed in strict accordance with the manufacturer's written installation instructions and applicable codes.
- B. Pipe Slope: Slope waste and vent piping as specified in Section 22 00 00.
- C. Damaged Piping: Any damaged piping shall be removed and replaced at the Contractor's expense.
- D. Expansion Provisions: All PPFR piping systems shall be installed with adequate provisions taken where the installation temperature is outside the range of 65°F to 85°F. Vertical expansion joint assemblies, offsets and restrain as recommended by the piping system manufacturer shall be provided wherever the installation temperature is more than 10°F different from the normal building temperature.

- E. Hangers and Supports: The entire piping system and related hangers and supports shall be installed such that the piping system is properly aligned and free of stress.

- 1. Vertical stacks shall be supported at each floor using riser clamps. The lowest riser support shall be located below the lowest coupling/hub on the stack and shall restrict sideways as well as downward motion.
- 2. Horizontal piping shall be supported using Clevis type hangers with maximum hanger spacing as follows:

PPFR Pipe Size	Support Spacing
1-1/2"	4' - 0"
2"	4' - 0"
3"	5' - 0"
4"	6' - 0"
6"	7' - 0"

- 3. Hangers shall also be located at each offset, bend or fitting on PPFR piping.

- F. Training: The Contractor shall instruct the Owner's maintenance staff the proper procedure for fusing acid waste pipe joints and shall provide the Owner with all special tools and fusing equipment required to properly fuse acid waste pipe joints.

3.2 TESTING:

- A. Test acid resistant waste and vent piping as specified in Sections 23 05 93 and 22 00 00. In addition to water test, apply peppermint or smoke tests, if required by local code.

3.3 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplate and labeling requirements.

END OF SECTION 22 05 00

SECTION 22 10 00 - PLUMBING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide pumps as specified, scheduled, and indicated.
- B. Types: The types of plumbing pumps required for the project include, but are not limited to, the following:
 - 1. **[Hydropneumatic]** domestic water pumping systems.
 - 2. Sewage ejectors.
 - 3. Sump pumps.
 - 4. Hot water circulating pumps.
 - 5. Elevator sump pumps.
 - 6. Remote plumbing pump annunciator panels.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
 - 1. Pumps:
 - a. Allis-Chalmers Corporation.
 - b. Armstrong Pumps, Inc.
 - c. Aurora Pump Company.
 - d. Bell and Gossett, ITT Division.
 - e. Burks.
 - f. Clow.
 - g. Crane Company.
 - h. Fairbanks-Morse.
 - i. Grundfos.
 - j. ITT A-C Pump.
 - k. Ingersol-Rand.
 - l. PACO Pumps.
 - m. Patterson.
 - n. Peabody-Barnes, Inc.
 - o. Peerless.
 - p. SyncroFlo, Inc.
 - q. Systecon.
 - r. Taco, Inc.
 - s. Thrush.
 - t. Weil Pump Company.
 - u. Weinman.
 - v. Worthington Pump Division, Dresser Industries.
 - w. Canariis Corporation
 - 2. Hydropneumatic Tanks:

- a. Amtrol, Inc.
 - b. Taco.
 - c. Woods.
- B. Electrical Standards: Provide electric motors and products which have been listed and labeled by Underwriters' Laboratories, Inc. (UL) and comply with National Electrical Manufacturers' Association (NEMA) standards.
- C. Certification, Pump Performance: Provide pumps whose performance, under specified conditions, is certified by the manufacturer.

1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Pump cut sheets with all pump capacities, characteristics, features, accessories and options clearly indicated.
 - 2. Pump curves with selection point clearly indicated.
 - 3. Motor data as required in Section 23 04 00.
 - 4. Control panel **[and] [,]** controller **[and remote annunciator]** information including front panel elevation, nameplate text, wiring diagram, component list and written system operational sequence.
 - 5. Hydropneumatic tank with all ratings, capacities, features and accessories listed.
 - 6. Sump and valve box drawings with all sizes, capacities, features and accessories listed.
 - 7. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver pumps, controllers, and accessories in factory-fabricated water-resistant wrapping.
- B. Handle pumps, controllers, and accessories carefully to avoid damage to material component, enclosure, and finish.
- C. Store pumps, controllers, and accessories in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 [HYDROPNEUMATIC] DOMESTIC WATER PUMPING SYSTEMS:

- A. General: Provide a prefabricated **[duplex,] [triplex,]** variable volume, constant speed, constant pressure domestic water pumping system consisting of a **[duplex] [triplex]** pump and motor set, **[hydropneumatic tanks]** a control panel and related piping and accessories, and capable of automatically providing system flows and pressures as scheduled and shown as on the Drawings.

[EDIT TO SUIT PROJECT]

- B. Operation: [The system shall be designed for one pump to run continuously and the second [and third] pump[s] to operate only at periods of high demand. A time switch shall be provided to shutdown the lead pump during off hours.] [The system shall be designed for the pumps to cycle on to meet flow demands. At time of low and/or no flow, all pumps shall remain off and the hydropneumatic tank draw down shall satisfy the system demand.] A lead/[lag] [lag1/lag2] switch shall be provided. Automatic controls shall be provided to shutdown all pumps at low inlet pressure conditions [and upon low water level in the break tank]. A low pressure alarm bell and light shall be provided. [The lag pump[s] shall cycle "ON" and "OFF" at pressures as scheduled below, subject to the minimum run timer.] Pumps are to be selected for a minimum increase in TDH between design and zero demand.

[INCLUDE ONLY WITHOUT HYDRO TANK]

1. **[Lag [1 and Lag 2] pump ON and OFF pressures shall be field adjustable and shall be factory preset as follows:**

<u>Pump</u>	<u>On Pressure</u>	<u>Off Pressure</u>
Lag 1 Domestic Water Pump	[] PSI	[] PSI
Lag 2 Domestic Water Pump	[] PSI	[] PSI]

[INCLUDE ONLY WITH HYDRO TANK]

- C. Hydropneumatic Tank: Provide, where shown on the Drawings, a vertical bladder type hydropneumatic tank with a minimum capacity of **[370] []** US gallons, and constructed for **[125] []** **psig** working pressure. Hydropneumatic tank shall be steel, designed and stamped in accordance with ASME and National Board Stamped with a replaceable heavy duty butyl diaphragm and rigid polypropylene liner, stainless steel inlet, relief, drain and charging connections, air charging valve hand hole and relief valve. Tank shall be factory precharged to provide the capacity specified.
- D. Pumps:

[SELECT ONE OF THE FOLLOWING]

1. **[Provide horizontal base mounted, flexible coupled, bronze fitted, rear pullout, centrifugal type, mechanical seal pumps of the size, capacity and head scheduled on the drawings. Pump selections and submittals shall be made using pressure versus flow curves. Pump discharge velocity shall not exceed 12'per second. The total dynamic head shall be maximum at no-flow and shall decrease from no flow to design flow. Shutoff head shall be at least 110% of design head but shall not exceed 140% of design head. All pump shall have dynamically balanced impellers and the critical speed of all pumps shall be at least 115% of the design speed. Pumps shall be free from flashing and cavitation at all flow rates from 25% to 125% of design flow under the suction conditions of the pump installation.]**

[OR]

2. **[Provide constant speed, vertical multistage diffuser pumps with stainless steel shafts, water-lubricated bronze radial bearings, mixed flow balanced bronze impellers, and cast iron bowls with glass-lined diffusers. Pump barrels shall have a corrosion-inhibiting lining. Discharge head shall be fabricated steel with continuous bypass for low seal pressure. Seal shall be sleeve-mounted and replaceable without motor removal, pump disassembly, or disturbing the piping connections. Each pump shall have vibration-isolating mounts and a reinforced flexible pipe connection on each pump discharge line.]**
3. Pumps, casings, fittings, flanges and seals shall be suitable for operation at **[150]** psig minimum and shall be suitable for use within the normal temperature operating ranges of the system in which they are installed. Pump suction and discharge flanges shall be ANSI **[125#]** flanges suitable for working pressures up to **[150]** psi. Pumps shall have carbon steel shafts, stainless steel shaft sleeves, bronze impeller, bronze front and rear casing wear rings, stainless steel impeller keys and steel casing bolts.
4. Mechanical seals shall be suitable for the working pressure and temperature of the pump application. All metal seal parts shall be 316 stainless steel. Mechanical seals shall be as manufactured by the John Crane Company and shall be suitable for the service specified. Seals for stuffing box working pressures of **[150]** psi shall be Type 1 or Type 2 **[un]**balanced seals. Seal material shall be Type BP (66) 1D1 for treated fluids up to 180°F.
5. All pumps shall have high-temperature grease-lubricated ball bearings with grease fittings and relief plugs. Bearings shall have 40,000 hours minimum life for suction pressures below 200 psi

and 20,000 hours minimum life for suction pressures 200 psi and above. Bearings shall limit impeller and mechanical seal face deflection to a maximum of 0.002".

6. Pump couplings shall be Woods Type SC Sure-flex flexible couplings. Coupling alignment shall be field calibrated to a maximum of 2 mils vibration.
7. All pumps shall have cast iron or fabricated steel drip lip bases with coupling guards, anchor bolts, provisions for grouting and shall have provisions for collection of all seal and condensation leakage. Motor and pump mounting surfaces shall be machined and the motor mounting shall include provisions for horizontal movement and alignment. A 3/4" minimum threaded outlet shall be provided in the base for drainage. All bases shall have sufficient strength to prevent vibration, warping and misalignment when installed without grouting. Bases on pumps shall be adequately stiffened to prevent flexing of panels.
8. Pump motors shall be **[energy efficient, high efficiency]** 1750 rpm open drip-proof type and shall be selected to drive the pump through its characteristic curve from zero flow to 125% of design flow without exceeding rated full load nameplate horsepower. Refer to Section 15140 for additional motor requirements.
9. Pumps with drive motors 10 hp and larger shall be individually factory capacity tested after final assembly. Provide certified copies of test results showing capacity, head, horsepower and efficiency at flow rates from shut off to 125% of design flow. The certification shall also indicate results of factory dynamic balance and pressure testing.

[INCLUDE ONLY WITHOUT HYDRO TANK]

10. **[To prevent casing overheat during periods of no flow, the contractor shall install individual bleed-off lines from the pump casings to the [surge tank] [nearest floor drain as shown on the Drawings]. Provide individual temperature control valves, solenoid valves and shutoff valves for each pump. The temperature control valve shall bleed water should pump casing water temperature exceed 90°F. The bleed-off solenoid valve (N.C.) shall be interlocked to open only when the pump is operating.]**

E. Control Panel:

1. The control panel shall be **[wall mounted] [free standing] [unit mounted]**, NEMA 1 construction, prewired for a single point electrical input with the following components:
 - a. **[Two] [Three]** FVNR magnetic starters with 3-phase overload protection, phase failure relays (Refer to Section 15140), fused disconnect switches with external operators and green run indicator lights for each pump.
 - b. **[Two] [Three]** H-O-A selector switches, one for each pump.
 - c. One manual alternator switch to select Lead and Lag **[1 or Lead and Lag 2]** pumps.
 - d. Adjustable mercoid pressure control and 0-30 minute adjustable run timer[s] for **[Lag Pump[s] [1 and 2]] [each pump]**.
 - e. One adjustable pressure control relay, panel mounted signal light and alarm bell with silence button for low pressure**[/low water level]** shutdown and alarm.
 - f. Fused Control Power Transformers.
 - g. Pump controls.

[SELECT ONE OF THE FOLLOWING]

- h. **[One 7 day time switch programmer which, at predetermined times shall shut down the lead pump. During this interval the lag pump shall respond to demands by sensing a drop in system pressure.]**

[OR]

- i. **[Programmable Controller shall have the following features:]**
 - 1) **[A nonvolatile memory with no battery back-up which prevents memory loss due to power failures.]**
 - 2) **[A program cartridge which allows program changes to be made by the factory and transmitted to the field for simple loading into the controller by the operator.]**
 - 3) **[The controller must be of modular construction so that input, output, processor, and memory sections may be replaced separately and easily.]**
 - 4) **[Input and output "ON" status lights must be supplied for ease of monitoring.]**
 - 5) **[The controller must be designed for use in locations where electromagnetic noise, high temperature, humidity, and mechanical shock may exist.]**
 - 6) **[The controller must also be UL and CSA-approved.]**
 - 7) **[Program features for [two] [three] pump systems shall include the following:]**
 - a) **[Adjustable time delays on all pump stop signals with automatic and manual time out.]**
 - b) **[Adjustable time delays on all lag pump start signals.]**
 - c) **[Flow switch control of lag pumps with minimum run timer.]**
 - d) **[Automatic and manual alternation of equal capacity pumps.]**
 - e) **[Automatic lag pump exerciser.]**
 - f) **[Multiple stage low system pressure alarm.]**
 - g) **[Multiple stage low suction pressure alarm.]**
 - h) **[Multiple stage high system pressure alarm.]**
 - i) **[Adjustable time delays for each alarm system.]**
 - j) **[An intermittent audible alarm horn.]**
 - k) **[Indication of first actuated alarm.]**
 - l) **[A single dry contact which indicated normal, alarm, and power failure conditions.]**
 - m) **[Lead pump shutdown capability for present or future use.]**
 - j. One set of engraved nameplates for all control switches and indicator lights.
 - k. One set of auxiliary contacts (N.C.) for low-pressure and power failure alarm. Contacts shall be held open under normal conditions and shall be closed under alarm. Contacts will be monitored by [_____].
 - l. One set of auxiliary contacts (N.O.) on starters for remote indication of pump operation. Contacts will be monitored by [_____].
 - m. One set of auxiliary contacts (N.O.) on starters for interlocking with casing solenoid valves.
 - n. One remote annunciator for domestic water pumps. Annunciator shall include run-light for each pump and a low pressure/power failure alarm light and sonolert with silence switch. (This annunciator may be combined with other Plumbing System equipment annunciators.)
2. The panel shall be internally prewired at the factory and tested in accordance with the provisions of the National Electrical Code. Panel shall have the UL-listing mark for industrial control panels.

3. **[The domestic water pump control panel shall be interlocked with a normally closed contact in the surge tank water level alarm such that all domestic water pumps are shutdown prior to the surge tank water level dropping below the pump suction connection [and with the fire pump controller[s] such that all domestic water pumps are shutdown on fire pump operation].]**
 4. **[A 120 volt alarm bell with flashing light, automatic reset silence button and engraved nameplate shall be furnished for installation and wiring by Division 16 as a low water level/ power failure alarm.]**
- F. Piping and Accessories: System shall include individual 4-1/2" ASA Grade A pressure gauges for pumps, indicating system, and suction pressures, all flush-mounted in a gauge panel directly above the power and control panel.

[EDIT TO SUIT PROJECT]

- G. Factory Assembly: The entire booster system shall be factory-prefabricated on a common structural steel stand with all interconnecting piping and wiring complete and operationally tested prior to shipment. Complete package shall also include isolation valves on the suction and discharge of each pump. **[Provide a pilot-operated pressure regulating valve on the inlet side of the pumping system to assure constant pressure on the suction side of pumps.]** System pressure shall be maintained by a pilot-operated diaphragm type, pressure-regulating valve on each pump discharge line. Valve body shall be cast iron with epoxy-coated cover and brass or epoxy-coated disc guide, disc retainer and diaphragm washer. In addition, separate spring loaded, nonslam type check valves shall be provided. **[Water side pipe connections to the hydropneumatic tank shall be between the discharge of the lead pump and its pressure reducing valve to assure constant pressure.]** Galvanized steel suction and discharge pipe manifolds, as well as copper tubing with shutoff cocks for gauges and pressure switches, will be furnished assembled. The only field connections required will be system suction, discharge, and power connection at the control panel.
- H. Factory Testing: The factory shall certify in writing that the water pressure booster system and its component parts have undergone a complete electric and hydraulic test prior to shipment. Test shall include a "System Operating Flow Test", from zero to 100% design flow rate under specified suction and net delivery pressure conditions. Certification shall include copies of the test data as recorded by the x-y plotter. System test may be witnessed by Owner, Architect, or Consulting Engineer by reporting intent to do so to the factory.
- I. Warranty: The internal multistage pumping assemblies and pressure regulating valves shall be guaranteed for 5 years from date of shipment against defective material and workmanship. Motors shall also be guaranteed for 5 years from date of shipment against burn-out from any cause when equipped with standard over temperature protection system and maintained according to factory instructions. The water pressure booster system, as a whole, shall be guaranteed in writing by the manufacturer for a period of one year from date of shipment against defects in design, materials, or construction.
- J. Start-up Service: A factory-trained representative shall be made available on the job site to check installation, provide system start-up and provide 8 hours of training for operating personnel.
- 2.2 HYDROPNEUMATIC DOMESTIC WATER PUMPING SYSTEM:
- A. General Provide a Hydropneumatic Domestic Water Pumping System consisting of a galvanized vertical bladder type hydropneumatic tank, a duplex pump and motor set, a control panel and related piping and accessories, capable of automatically providing system flows and pressures as scheduled and as shown on the Drawings.
- B. Operation: One pump shall be selected as the lead pump and will start and stop in response to its pressure switch which shall be set for [] psi off, [] psi on. Should the pressure drop to [] psi, the second pump (designated as the lag pump) shall commence operation and shall remain in operation until system pressure reaches [] psi, at which time the lag pump shall

shutdown. The controls shall also incorporate a minimum run timer which shall hold the pumps in operation for a minimum of 3 minutes once they have started.

1. At time of low and/or no flow, pumps shall remain off and the hydropneumatic tank drawdown shall satisfy the system demands.

- C. Hydropneumatic Tank: Provide, where shown on the Drawings, a vertical bladder type hydropneumatic tank with a minimum capacity of **[86]** [] US gallons, and constructed for **[125 psig]** [] **psig** working pressure. Minimum drawdown shall be **[30.7]** [] US gallons. Hydropneumatic tank shall be steel, designed and stamped in accordance with ASME and National Board stamped with a replaceable heavy duty butyl diaphragm and rigid polypropylene liner, stainless steel inlet, relief, drain and charging connections, air charging valve hand hole and relief valve. Tank shall be factory pre-charged to provide the capacity specified.

- D. Pumps:

[SELECT ONE OF THE FOLLOWING]

1. **[Provide horizontal base mounted, flexible coupled, bronze fitted, rear pullout, centrifugal type, mechanical seal pumps of the size, capacity and head scheduled on the drawings. Pump selections and submittals shall be made using pressure versus flow curves. Pump discharge velocity shall not exceed 12'per second. The total dynamic head shall be maximum at no-flow and shall decrease from no flow to design flow. Shutoff head shall be at least 110% of design head but shall not exceed 140% of design head. All pump shall have dynamically balanced impellers and the critical speed of all pumps shall be at least 115% of the design speed. Pumps shall be free from flashing and cavitation at all flow rates from 25% to 125% of design flow under the suction conditions of the pump installation.]**

[OR]

2. **[Pumps shall be constant speed, vertical multistage diffuser pumps with stainless steel shafts, water-lubricated bronze radial bearings, mixed flow balanced bronze impellers, and cast iron bowls with glass-lined diffusers. Pump barrels shall have a corrosion-inhibiting lining. Discharge head shall be fabricated steel with continuous bypass for low seal pressure. Seal shall be sleeve-mounted and replaceable without motor removal, pump disassembly, or disturbing the piping connections. Each pump shall have vibration-isolating mounts and a reinforced flexible pipe connection on each pump discharge line.]**
3. Pumps, casings, fittings, flanges and seals shall be suitable for operation at **[150]** psig minimum and shall be suitable for use within the normal temperature operating ranges of the system in which they are installed. Pump suction and discharge flanges shall be ANSI **[125#]** flanges suitable for working pressures up to **[150]** psi. Pumps shall have carbon steel shafts, stainless steel shaft sleeves, bronze impeller, bronze front and rear casing wear rings, stainless steel impeller keys and steel casing bolts.
4. Mechanical seals shall be suitable for the working pressure and temperature of the pump application. All metal seal parts shall be 316 stainless steel. Mechanical seals shall be as manufactured by the John Crane Company and shall be suitable for the service specified. Seals for stuffing box working pressures of **[150]** psi shall be Type 1 or 2 **[un]**balanced seals. Seal material shall be Type BP (66) 1D1 for treated fluids up to 180°F.
5. All pumps shall have high-temperature grease-lubricated ball bearings with grease fittings and relief plugs. Bearings shall have 40,000 hours minimum life for suction pressures below 200 psi and 20,000 hours minimum life for suction pressures 200 psi and above. Bearings shall limit impeller and mechanical seal face deflection to a maximum of 0.002".

6. Pump couplings shall be Woods Type SC Sure-flex flexible couplings. Coupling alignment shall be field-calibrated to a maximum of 2 mils vibration.
7. All pumps shall have cast iron or fabricated steel drip lip bases with coupling guards, anchor bolts, provisions for grouting and shall have provisions for collection of all seal and condensation leakage. Motor and pump mounting surfaces shall be machined and the motor mounting shall include provisions for horizontal movement and alignment. A 3/4" minimum threaded outlet shall be provided in the base for drainage. All bases shall have sufficient strength to prevent vibration, warping and misalignment when installed without grouting. Bases on pumps shall be adequately stiffened to prevent flexing of panels.
8. Pump motors shall be **[energy efficient, high efficiency]** 1750 rpm open drip-proof type and shall be selected to drive the pump through its characteristic curve from zero flow to 125% of design flow without exceeding rated full load nameplate horsepower. Refer to Section 15140 for additional motor requirements.
9. Pumps with drive motors 10 hp and larger shall be individually factory capacity tested after final assembly. Provide certified copies of test results showing capacity, head, horsepower and efficiency at flow rates from shut off to 125% of design flow. The certification shall also indicate results of factory dynamic balance and pressure testing.

E. Control Panel:

1. The control panel shall be wall mounted, NEMA 1 construction, prewired for a single point electrical connection with the following components:
 - a. Two FVNR magnetic starters with 3-phase overload protection, phase failure relays (Refer to Section 15100), fused disconnect switches, and green run indicator lights for each pump.
 - b. Two H-O-A selector switches, one for each pump.
 - c. One manual alternator switch to select lead and lag pumps.
 - d. Two adjustable mercoid pressure controls and adjustable 0 - 10 minute run timers, (one for each pump).
 - e. One fused Control Power Transformer.
 - f. One adjustable pressure control relay, panel mounted signal light and alarm bell with silence button for low pressure **[/low water pressure]** shutdown and alarm.
 - g. One set of engraved nameplates for all control switches and indicator lights.
 - h. Two pump run time meters, one for each pump.
 - i. One set of auxiliary contacts (N.C.) for low-pressure and power failure alarm. Contacts shall be held open under normal conditions and shall be closed under alarm. Contacts will be monitored by **[_____]**.
 - j. One set of auxiliary contacts (N.O.) on starters for remote indication of pump operation. Contacts will be monitored by **[_____]**.
 - k. **[One remote annunciator for domestic water pumps. Annunciator shall include run-light for each pump and a low pressure/power failure alarm light and sonolert with silence switch. (This annunciator may be combined with other plumbing system equipment annunciators). The panel shall be internally prewired at the factory and tested in accordance with the provisions of the National Electrical Code. Panel shall have the UL-listing mark for industrial control panels.]**
2. The panel shall be internally prewired at the factory and tested in accordance with the provisions of the National Electrical Code. Panel shall have the UL-listing mark for industrial control panels.

3. **[The domestic water pump control panel shall be interlocked with a normally closed contact in the surge tank water level alarm such that all domestic water pumps are shutdown prior to the surge tank water level dropping below the pump suction connection and with the fire pump controller[s] such that all domestic water pumps are shutdown on fire pump operation].**
4. **[A 120 volt alarm bell with flashing light, automatic reset silence button and engraved nameplate shall be furnished for installation and wiring by Division 16 as a low water level/power failure alarm.]**

F. Piping and Accessories:

1. System pressure shall be maintained by a pilot-operated diaphragm type, pressure-regulating valve on each pump discharge line. Valve body shall be cast iron with epoxy-coated cover and brass or epoxy-coated disc guide, disc retractor and diaphragm washer. In addition, separate spring loaded, nonslam type check valves shall be provided. Water side pipe connections to tank shall be between the discharge of the lead pump and its pressure reducing valve to assure constant pressure.
2. System shall include individual 4-1/2" ASA Grade A pressure gauges for pumps, indicating system and suction pressures, all flush-mounted in a gauge panel directly above the control panel.
3. **[Provide a pilot-operated pressure regulating valve on the inlet side of the pumping system to assure constant pressure on the suction side of the pumps.]**

G. Factory Assembly: The entire booster system shall be factory-prefabricated on a common structural steel stand with all interconnecting piping and wiring complete and operationally tested prior to shipment. Complete package shall also include isolation valves on the suction and discharge of each pump. Galvanized steel suction and discharge pipe manifolds, as well as copper tubing with shutoff cocks for gauges and pressure switches, will be furnished assembled. The only field connections required will be system suction, discharge, and power connection at the control panel.

H. Factory Testing: The factory shall certify in writing that the water pressure booster system and its component parts have undergone a complete electric and hydraulic test prior to shipment. Test shall include a "System Operating Flow Test", from zero to 100% design flow rate under specified suction and net delivery pressure conditions. Certification shall include copies of the test data as recorded by the x-y plotter. System test may be witnessed by Owner, Architect, or Consulting Engineer by reporting intent to do so to the factory.

I. Warranty: The internal multistage pumping assemblies and pressure regulating valves shall be guaranteed for 5 years from date of shipment against defective material and workmanship. Motors shall also be guaranteed for 5 years from date of shipment against burn-out from any cause when equipped with standard over temperature protection system and maintained according to factory instructions. The water pressure booster system, as a whole, shall be guaranteed in writing by the manufacturer for a period of one year from date of shipment against defects in design, materials, or construction.

J. Start-up Service: A factory-trained representative shall be made available on the job site to check installation, provide system start-up and provide 8 hours of training for operating personnel.

2.3 SEWAGE EJECTORS:

[REFER TO ALTERNATE TEXT BELOW]

A. General: Provide a duplex, packaged submersible sewage ejector system designed for discharge **[through the cover] [below the cover]**. The system shall be complete with all required components including, but not limited to: **[fiberglass pump basin,] [basin cover]**, submersible pumps, pump quick removal system, waterproof junction box, float switch controls and a system control panel.

Sewage ejector capacity and electrical characteristics shall be as scheduled and as shown on the Drawings.

[SELECT ONE OF THE FOLLOWING]

[VERIFY OPERATION]

B. System Operation: Provide system operation as follows:

1. On liquid level rise in the pump basin, the lowest level (first) mercury switch shall energize, then the next level (second) switch shall energize, starting the lead pump. Lead pump shall operate until the lowest level switch is de-energized.
2. On next liquid level rise, the lag pump shall be started and again shall operate until the lowest level switch is de-energized.
3. Should liquid level continue to rise when the lead pump is operating, the lag (third) switch shall be energized, starting the idle or standby pump. Both pumps shall continue to operate until the lowest level switch is de-energized.
4. Should liquid level continue to rise after both pumps are operating, the alarm (fourth) switch shall be energized, operating the visual and audible alarms.

[SELECT BASIN TYPE]

- C. Pump Basin and Valve Box: **[The pump basin and valve box shall be constructed of concrete, by the General Contractor, as detailed on the Drawings. This Division shall be responsible for coordinating basin provisions for system installation.] [The pump basin shall be constructed of fiberglass in either 60" or 72" diameter with depth as required or shown on the Drawings. The integral valve box shall also be constructed of fiberglass to the depth required or shown on the Drawings. The bottom of the basin shall be reinforced with two 3" steel H-beams, extending beyond diameter of basin for anchoring to concrete pad. Lifting lugs shall be provided on the outside of the valve box and the basin sections for ease in handling. A top flange of the valve box-pump basin segment of the unit for mounting the basin cover. Pump mounting plates shall be bolted to steel plates fastened to the bottom of the fiberglass basin.]]**
- D. Basin Cover: **A hot dip galvanized, gas tight gasketed steel basin cover with gasketed access doors shall be provided. Basin cover shall be a nonslip design suitable for use in areas with pedestrian traffic. Separate access doors shall be provided for each pump [and for the valve box]. The basin cover shall be [a round style designed to fully cover the concrete basin shown on the Drawings.] [designed to cover the fiberglass basin/valve box specified.] [a rectangular style designed for installation in a case-in-place concrete basin as shown on the Drawings.] Access doors shall be equipped with [lift handles and hinges.] [a hasp, hinges, and a tension bar spring.] [Basin covers shall be suitably reinforced to withstand vehicular traffic.]**
- E. Piping: **[Discharge piping from the quick removal elbow shall be field-installed.] [All piping inside the lift station shall be factory installed and tested. The discharge piping from the pumps shall be [4"] [____"], mounted in the basin and extended through the floor of the valve box and joined by flanged connections to the piping, valves and fittings contained in the integral valve box. The individual pump discharge lines shall be joined within the integral valve box to a common discharge line extending horizontally from the valve box and terminating in a 4" plain end pipe. Where the piping passes through the wall of the valve box, a flexible link-type seal within an integral sleeve shall be furnished, to provide a gas and watertight seal. A drain, with a check valve seal, to prevent water from the basin entering the valve box, shall be furnished in the valve box and piped to the basin.]**
- F. Submersible Pumps:
1. A duplex set of submersible pumps shall be provided. Pumps shall be capable of handling raw, unscreened sewage, sand, silt and other soft material at temperatures up to 140°F. Each pump

shall be equipped with a hermetically sealed, Class "F" insulated motor, installed in a heavy, ribbed cast iron shell. The motor shell, pump volute and impeller shall be made of close-grained cast iron (ASTM A48-C30). Pump shaft shall be 316 stainless steel and all fastening hardware shall be stainless steel.

2. The pump impeller shall be two-vane, nonclog type, accurately machined to the proper diameter, and dynamically balanced prior to installation in pump. The pump unit shall be furnished with "Y" guides, stainless steel lifting cable, a removable discharge elbow and all necessary hardware.
3. The pump unit shall be furnished with a moisture sensing probe and relay panel with light to indicate entrance of water to the motor.
4. Pump and motor unit to receive a coat of red chromate primer and a finish coat of water resistant enamel.

G. Quick Removal System: A quick removal system shall be provided. A separate steel base plate, incorporating a stationary discharge elbow with flexible connector for pump discharge line and bottom guide rail supports for proper alignment shall be furnished. System shall include galvanized guide rails terminating into guide rail supports at the main cover. A gasket shall be furnished between the mating faces of the pump elbow and the fixed discharge elbow to facilitate removal and prevent corrosive bridging, no portion of the pump shall touch the floor of the basin.

H. Control Panel:

1. The control panel furnished shall be UL-listed NEMA 3R, dead front with blank gasketed and lockable weatherproof door and an internal dead front safety door. The control panel shall be designed for a **[single] [dual]** incoming branch circuit power feed. Panel shall contain a motor disconnect switch, a magnetic starter with 3-phase overload protection and a phase failure relay (Refer to Section 15140) for each pump. An alternating relay, to alternate lead pump, shall be provided. Panel to have a "Test-Off-Auto" selector switch and a pilot "Run" light for each pump. Control transformers for 115 control power shall be provided. **[Where a dual power feed is specified, separate control power transformers shall be provided for each feed.]**
2. Panel shall also include audible and visual alarm signals with provisions for silencing the audible alarm and dry alarm contacts for remote monitoring by [_____]. Signals shall be provided for "HIGH LEVEL", "PUMP 1 MOISTURE", and "PUMP 2 MOISTURE".
3. A NEMA 6 junction box shall be **[provided for field mounting] [factory-mounted]** in the **[valve box chamber] [pump basin]**. The junction box will be provided with a terminal strip to accommodate all necessary power and control wiring and have suitable watertight sealing means for all cables. Junction box and cable entrance fittings to meet NEMA 6 waterproof requirements.

I. Basin Level Controls: Provide mercury float type liquid level control for proper pump and alarm operation. Four 2-pole mercury switches, each sealed in a corrosion-resistant polypropylene float shall be provided. Each switch to have a PVC-coated, UL-listed cable and to be attached to a corrosion-resistant bracket to a galvanized suspension rod. The switch bracket to be provided with a reinforcing sleeve to prevent sharp bending and damage to cable.

J. Factory Testing: Before shipping all component parts shall be tested for compliance with the hydraulic, mechanical and electrical requirements of the specifications. After assembly and testing, units exceeding 7'-6" overall height shall be broken down into sub-assemblies for ease of handling and shipment. Subassemblies shall be match marked. Complete installation, operating and maintenance instructions shall be provided by the pump manufacturer.

K. Start-up Service: System checkout, start-up, and adjustment shall be provided by a representative of the system manufacturer.

2.4 SEWAGE EJECTORS AND SUMP PUMPS:

- A. General: Provide sewage ejectors of the type, capacity, duty, motor horsepower, and speed as scheduled on the Drawings. Furnish grease-lubricated intermediate guide bearings for every 6' length of pump shaft.
- B. Sumps and Covers: Sump pits shall be constructed under Division 3, "Concrete". This Contractor shall furnish and install a steel cover plate and ring for each sump pit. Cover plate shall have 1-1/2" x 1-1/2" x 1/4" structural steel angle reinforcement on the underside, gasketed gastight bolted manhole, and threaded or flanged vent connection. Furnish and install a gastight steel base plate equipped with a lantern ring shaft stuffing box and means for removing each of the pumps separately without removing the large gastight cover.
- C. Impellers: Sewage ejector impellers shall be nonclog-type capable of pumping a 2-1/2" sphere. The pump casing and suction cover shall be of cast iron. The casing shall be provided with a cast integral discharge elbow. The shaft shall be stainless steel. The pump shall be suitable for handling drainage containing sand and a water temperature of 140°F.

[VERIFY REMOTE ALARM REQUIREMENT]

- D. Controls: Provide a nonfloat type control with high water alarm contacts for each pump, with provisions for actuating a local **[and remote]** alarm **[in the Building Control and Automation Systems' office (refer to Paragraph 2.08)]**. Alternator shall be as manufactured by Allen-Bradley or approved equal. Control panel shall be a factory-wired NEMA Type 1 enclosure and shall include a disconnect switch, alternator, FVNR starter with circuit breaker for each motor, control panel-mounted high level alarm bell, control power transformer with fused disconnect switch tapped from the line side of the pump disconnect switch and pump running lights. Alarm switch and all controls shall **[be rated for] [operate on]** 120 volt, 60 Hz, alternating current. Pump motor and electrical controls, including switch and motor controller, shall be mounted on an integral steel frame 2' above the level of the floor on which pump is located. This will allow the pumps to operate during any emergency flooding. Upper shaft bearing shall be at least 6" above pit cover plate. The Contractor shall provide the necessary steel framework and supports for elevating the electrical equipment by means acceptable to the Architect and Engineer.

2.5 SUMP PUMPS (SUBMERGED-TYPE):

- A. General: Provide sump pumps of the type, capacity, and duty shown on the Drawings. The pumps shall have a cast iron casing and shall be equipped with bronze enclosed impellers dynamically balanced for all hydraulic loads within the operating range of the pump. Tripod support shall be integrally cast with pump casing. The design of the pump shall permit removal of motor shaft/impeller assembly without the need to disconnect the discharge piping or remove the pump casing from the basin. Pumps shall be capable of handling drainage containing sand and a water temperature of 105°F.
- B. Sumps and Covers: Sump pits shall be constructed under Division 3, "Concrete". This Contractor shall furnish and install a steel cover plate and ring for each sump pit. Cover plate shall have 1-1/2" x 1-1/2" x 1/4" structural steel angle reinforcement on the underside gasketed gastight, bolted manhole, and threaded or flanged vent connection.

[VERIFY REMOTE ALARM REQUIREMENT]

- C. Controls: Provide a float switch with gastight rubber bellows, bronze float and rods, alternator, high level automatic alarm switch with gastight rubber bellows, and provisions for activation of a local **[and remote]** alarm **[in the Building Control and Automation Systems' (refer to Paragraph 2.08)]**. Control panel shall be a factory-wired NEMA Type 1 enclosure and shall include a disconnect switch, alternator, FVNR motor starter with circuit breaker, control panel-mounted high level alarm bell, control power transformer with fused disconnect switch tapped from the line side of the pump disconnect switch, and pump running lights. Alarm switch and all controls shall **[be rated for] [operate on]** 120 volt, 60 Hz alternating current.

- D. Motors: Motors shall be of the oil-filled, totally-enclosed, immersible design. Each motor shall be of the ball-bearing type, equipped with a stainless steel shaft, expansion diaphragm, and a face-type seal on output shaft to seal motor from the liquid being pumped. Each motor shall be supplied with not less than 10' of immersible unitized cable.

2.6 SUBMERSIBLE SUMP PUMPS:

[REFER TO ALTERNATE TEXT ABOVE]

- A. General: Provide a duplex, packaged submersible sump pump system designed for discharge **[through the cover] [below the cover]**. The system shall be complete with all required components including, but not limited to: **[fiberglass pump basin,] [basin cover]**, submersible pumps, pump quick removal system, waterproof junction box, float switch controls and a system control panel. Sump pump capacity and electrical characteristics shall be as scheduled and as shown on the Drawings.

[SELECT ONE OF THE FOLLOWING]

[VERIFY OPERATION]

- B. System Operation: Provide system operation as follows:
1. On liquid level rise in the pump basin, the lowest level (first) mercury switch shall energize, then the next level (second) switch shall energize, starting the lead pump. Lead pump shall operate until the lowest level switch is de-energized.
 2. On next liquid level rise, the lag pump shall be started and again shall operate until the lowest level switch is de-energized.
 3. Should liquid level continue to rise when the lead pump is operating, the lag (third) switch shall be energized, starting the idle or standby pump. Both pumps shall continue to operate until the lowest level switch is de-energized.
 4. Should liquid level continue to rise after both pumps are operating, the alarm (fourth) switch shall be energized, operating the visual and audible alarms.

[SELECT BASIN TYPE]

- C. Pump Basin and Valve Box: [The pump basin and valve box shall be constructed of concrete, by the General Contractor, as detailed on the Drawings. This Division shall be responsible for coordinating basin provisions for system installation.] [The pump basin shall be constructed of fiberglass in either 60" or 72" diameter with depth as required or shown on the Drawings. The integral valve box shall also be constructed of fiberglass to the depth required or shown on the Drawings. The bottom of the basin shall be reinforced with two 3" steel H-beams, extending beyond diameter of basin for anchoring to concrete pad. Lifting lugs shall be provided on the outside of the valve box and the basin sections for ease in handling. A top flange of the valve box-pump basin segment of the unit for mounting the basin cover. Pump mounting plates shall be bolted to steel plates fastened to the bottom of the fiberglass basin.]
- D. Basin Cover: A hot dip galvanized, gas tight gasketed steel basin cover with gasketed access doors shall be provided. Basin cover shall be a nonslip design suitable for use in areas with pedestrian traffic. Separate access doors shall be provided for each pump **[and for the valve box]**. The basin cover shall be **[a round style designed to fully cover the concrete basin shown on the Drawings.] [designed to cover the fiberglass basin/valve box specified.] [a rectangular style designed for installation in a case-in-place concrete basin as shown on the Drawings.]** Access doors shall be equipped with **[lift handles and hinges.] [a hasp, hinges, and a tension bar spring.]** [Basin covers shall be suitably reinforced to withstand vehicular traffic.]

- E. Piping: **[Discharge piping from the quick removal elbow shall be field-installed.]** All piping inside the lift station shall be factory installed and tested. The discharge piping from the pumps shall be **[4"]** **[_____"]**, mounted in the basin and extended through the floor of the valve box and joined by flanged connections to the piping, valves and fittings contained in the integral valve box. The individual pump discharge lines shall be joined within the integral valve box to a common discharge line extending horizontally from the valve box and terminating in a 4" plain end pipe. Where the piping passes through the wall of the valve box, a flexible link-type seal within an integral sleeve shall be furnished, to provide a gas and watertight seal. A drain, with a check valve seal, to prevent water from the basin entering the valve box, shall be furnished in the valve box and piped to the basin.
- F. Submersible Pumps:
1. A duplex set of submersible pumps shall be provided. Pumps shall be capable of handling raw, unscreened sand, silt and other soft material at temperatures up to 140°F. Each pump shall be equipped with a hermetically sealed, Class "F" insulated motor, installed in a heavy, ribbed cast iron shell. The motor shell, pump volute and impeller shall be made of close-grained cast iron (ASTM A48-C30). Pump shaft shall be 316 stainless steel and all fastening hardware shall be stainless steel.
 2. The pump impeller shall be two-vane, nonclog type, accurately machined to the proper diameter, and dynamically balanced prior to installation in pump. The pump unit shall be furnished with "Y" guides, stainless steel lifting cable, a removable discharge elbow and all necessary hardware.
 3. The pump unit shall be furnished with a moisture sensing probe and relay panel with light to indicate entrance of water to the motor.
 4. Pump and motor unit to receive a coat of red chromate primer and a finish coat of water resistant enamel.
- G. Quick Removal System: A quick removal system shall be provided. A separate steel base plate, incorporating a stationary discharge elbow with flexible connector for pump discharge line and bottom guide rail supports for proper alignment shall be furnished. System shall include galvanized guide rails terminating into guide rail supports at the main cover. A gasket shall be furnished between the mating faces of the pump elbow and the fixed discharge elbow to facilitate removal and prevent corrosive bridging, no portion of the pump shall touch the floor of the basin.
- H. Control Panel:
1. The control panel furnished shall be UL-listed NEMA 3R, dead front with blank gasketed and lockable weatherproof door and an internal dead front safety door. The control panel shall be designed for a **[single] [dual]** incoming branch circuit power feed. Panel shall contain a motor disconnect switch, a magnetic starter with 3-phase overload protection and a phase failure relay (Refer to Section 15140) for each pump. An alternating relay, to alternate lead pump, shall be provided. Panel to have a "Test-Off-Auto" selector switch and a pilot "Run" light for each pump. Control transformers for 115 control power shall be provided. **[Where a dual power feed is specified, separate control power transformers shall be provided for each feed.]**
 2. Panel shall also include audible and visual alarm signals with provisions for silencing the audible alarm and dry alarm contacts for remote monitoring by **[_____]**. Signals shall be provided for "HIGH LEVEL", "PUMP 1 MOISTURE", and "PUMP 2 MOISTURE".
 3. A NEMA 6 junction box shall be **[provided for field mounting] [factory-mounted]** in the **[valve box chamber] [pump basin]**. The junction box will be provided with a terminal strip to accommodate all necessary power and control wiring and have suitable watertight sealing means for all cables. Junction box and cable entrance fittings to meet NEMA 6 waterproof requirements.
- I. Basin Level Controls: Provide mercury float type liquid level control for proper pump and alarm operation. Four 2-pole mercury switches, each sealed in a corrosion-resistant polypropylene float shall be provided. Each switch to have a PVC-coated, UL-listed cable and to be attached to a

corrosion-resistant bracket to a galvanized suspension rod. The switch bracket to be provided with a reinforcing sleeve to prevent sharp bending and damage to cable.

- J. Factory Testing: Before shipping all component parts shall be tested for compliance with the hydraulic, mechanical and electrical requirements of the specifications. After assembly and testing, units exceeding 7'-6" overall height shall be broken down into sub-assemblies for ease of handling and shipment. Subassemblies shall be match marked. Complete Installation, Operating and Maintenance instructions shall be provided by the pump manufacturer.
- K. Start-up Service: System checkout, start-up, and adjustment shall be provided by a representative of the system manufacturer.

2.7 HOT WATER CIRCULATING PUMPS:

- A. General: Provide all bronze, in line hot water circulating pumps with capacities and electrical characteristics as scheduled and as shown on the Drawings. Pumps shall be suitable for working pressures **[up to [125] [175] psi] [as scheduled on the Drawings]** and water temperatures up to 300°F per ASA B16.1. Pumps shall be fitted with a dynamically balanced brass enclosed type impeller with mechanical seal. Mechanical seal shall be Type 1 or Type 2 material, Code BP-1D1 as manufactured by John Crane Company or an approved equal, suitable for service specified. Pumps, casings, flanges, and seals shall be suitable for operation with the working pressures and temperatures scheduled and indicated. The scheduled working pressure applies to the entire pump assembly.
 - 1. Pumps shall be non-overloading and shall have easily replaceable mechanical seals. Impeller shall be cast bronze, dynamically balanced. All wetted parts shall be bronze or cupro-nickel. Bearings shall be sleeve or ball type.
- B. Motors: Pump motors shall be resiliently mounted, flexible or magnetically coupled and shall not require external overload protection on single phase motors. Motor shall have a maximum speed of 1750 rpm. Refer to Section 15140 for additional requirements.
- C. Controls: Pumps shall be provided with a Johnson Controls Series A19DAC-1 hot water circulator control **[and an automatic alternator]**. Controller shall be set to start the **[lead]** pump when the loop temperature drops below **[10°F (adjustable) below design temperature] [_____°F]** and stop the pump when loop temperature reaches **[design temperature] [_____°F]**. **[The alternator shall be wired to change the lead pump at each start.]**
- D. Time Switch: Pumps shall be provided with a Tork W100 or equal 7 day dial electro mechanical time switch in a NEMA 1 enclosure.

2.8 ELEVATOR SUMP PUMPS:

- A. General: Provide complete and operational elevator sump pumps as specified herein, as scheduled and as shown on the Drawings.
- B. Pumps: The elevator sump pump shall be cast iron shell with bronze impeller, 303 stainless steel shaft and housing, motor shall be hermetically sealed with built-in overload protection, bearings shall be factory sealed grease lubricated ball type. Pump capacities shall be as scheduled on the Drawings.
- C. Controls: Pump shall include factory installed integral low level micro switch to turn pump on at 5" water depth and shut off at 3-3/4" water depth.

VERIFY REMOTE ANNUNCIATOR REQUIREMENTS

2.9 REMOTE PLUMBING PUMP ANNUNCIATOR PANELS:

- A. General: Provide a flush-mounted alarm annunciator **[at the Control and Automation Systems' office]**. The annunciator shall include an indicator light for each alarm to be annunciated and a common audible alarm with silence switch. The silence switch shall not prevent the audible alarm

from resounding for subsequent alarms. If the alarm contact is reset and the silence switch is not reset, then the audible alarm shall sound until the switch is reset. Alarms to be annunciated shall include:

1. Domestic water **[cooling tower]** pump shutdown for each individual pumping system.
 2. Sump pump high level alarms for each sump pump.
 3. Sewage ejector high level alarms for each sewage ejector.
 4. **[Position for each fire pump.]**
 5. **[Jockey pump input power failure for each jockey pump.]**
 6. Break tank high and low level alarms for each break tank.
 7. Boiler low water level alarm for each boiler.
 8. **[Four]** spare lamps for future alarms.
- B. Labeling: Label each alarm lamp with an engraved nameplate identifying the alarm indicated.
- C. Power Source: The remote annunciator shall be served by a dedicated 120 volt emergency power branch circuit.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. General: Installer shall examine conditions under which pumps are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 TYPICAL INSTALLATION OF PUMPS:

- A. General: Install pumps where shown, in accordance with manufacturer's written instructions and recognized industry practices to ensure that pumps comply with requirements and serve intended purposes. Comply with NEMA standards and requirements of NEC.
- B. Base-mounted Pumps: Pumps shall be leveled, bolted, and grouted to pump bases. Piping shall be arranged so pump cases are not subjected to any piping forces. Contractor shall check for proper angular and concentric alignment of pumps and motors and shall get Engineer's approval of this alignment before pumps are operated.
- C. Alignment: Check alignment and, where necessary, realign shafts of motors and pumps within tolerances recommended by manufacturer.
- D. Housekeeping Pads/Vibration Isolation: Refer to Section 15100 and Section 15250 for applicable requirements.
- E. Drain Lines: Provide a drain line (3/4" minimum) for each pump drip base to the nearest floor drain.
- F. Casing Relief Valves: Provide individual casing relief drain lines from each **[domestic water]** **[and]** **[fire]** pump casing relief valve **[to the]** **[nearest floor drain]** **[house/break tank]**.
- G. **[Hydropneumatic Tanks: Pipe and install hydropneumatic tank as shown on the drawings and per manufacturers recommendations. Adjust tank air charge to provide specified drawdown capacity.]**

3.3 ELECTRICAL CONNECTIONS:

- A. Controllers and Annunciators: Set pump controllers and annunciators in place for wiring by Division 16.
- B. Grounding: Provide positive electrical pump and motor grounding in accordance with applicable requirements of the NEC.

3.4 COORDINATION:

- A. General: This Contractor shall be responsible for coordinating installation requirements and provisions with the work of other Divisions and the General Contractor.
- B. **[Sumps: This Contractor shall be responsible for coordinating the [construction] [installation] of [field-constructed] [factory-fabricated] sumps with the work of the General Contractor. This coordination shall include, but not be limited to, [location, sump size and shape, sump depth, pipe and conduit entries and exits, and cover/access door installation.]**
- C. **[Construction Pumping: All construction sewage and storm drainage pumping shall be done with temporary equipment. After building is completely closed in and lower floors are broom clean and dry, the sumps shall be emptied and cleaned to the surface of the bottom of the pit. At that time, permanent sump and sewage pumps shall be installed, lubricated, adjusted, checked and placed in service.]**

3.5 START-UP SERVICES:

- A. General: The pump supplier shall provide pump checkout, start-up, testing and adjusting of system components for the **[domestic water,] [sewage ejector,] [sump,] [and] [hot water circulating]** pumps. The pump supplier shall also train the Owner's Engineer in the proper operation and maintenance of **[these] [this]** pump system[s].
- B. Checkout: After pumps have been in operation for 90 days, the contractor shall check all seals and replace any which are defective.

3.6 TESTING:

- A. General: Test and adjust all installed plumbing pumps[,] **[and]** controllers[, and annunciators] to verify proper operation as specified herein and as recommended by the manufacturers. Where specified hereinabove, start-up, testing, and adjustment shall be provided by a representative of the equipment supplier.
- B. Functional Tests: Test pumps[,] **[and]** controllers, **[and annunciators]** to verify that all control, alarm and indicator functions operate properly and to verify that pump discharge pressures and flows are as specified.
- C. Refer to Section 23 05 93 for additional start-up, testing, and adjustment requirements.

3.7 IDENTIFICATION:

- A. Refer to Section 23 03 00 "Basic Materials and Methods", for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 10 00

SECTION 22 10 10

PLUMBING PIPING VALVES AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 APPLICABLE PUBLICATIONS

NSF/ANSI 61 --Drinking Water System Components – Health Effects

NSF/ANSI 372 -- Drinking Water System Components – Lead Content

1.3 DESCRIPTION OF WORK:

- A. Work Included: Provide plumbing piping valves and accessories as specified, and indicated.
- B. Types: The types of plumbing piping valves and accessories required for the project include, but are not limited to:
 - 1. Valves.
 - 2. Strainers.
 - 3. Unions.
 - 4. Flanges.
 - 5. Gaskets.
 - 6. Flexible connections.
 - 7. Gauges.

1.4 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable, subject to compliance with the requirements of these Specifications.
 - 1. General Valves:
 - a. Crane Company.
 - b. Jenkins Bros. Valves.
 - c. Lunkenheimer.
 - d. Nibco.
 - e. Red and White.
 - f. Stockham Valves and Fittings.
 - g. Walworth Company.
 - h. Flomatic valves.
 - i. KITZ.
 - 2. Ball Valves:
 - a. Apollo.
 - b. Crane Company.
 - c. Jenkins Bros. Valves.
 - d. Nibco.
 - e. Red and White.
 - f. Stockham Valves and Fittings.
 - g. Victaulic.

- h. KITZ.
- 3. Backflow Preventers/Pressure Reducing Valves:
 - a. Febco.
 - b. Hersey Products, Inc.
 - c. Watts Regulator Company.
 - d. Flomatic valves.
- 4. Check Valves:
 - a. Crane Company.
 - b. Jenkins Bros. Valves.
 - c. Mission.
 - d. Muesco, Inc.
 - e. Williams-Hager, Clow Pipeline Products, Valve Division.
 - f. Victaulic.
 - g. Flomatic valves.
 - h. KITZ.
- 5. Strainers:
 - a. Crane.
 - b. Keckley.
 - c. Muessco.
 - d. Victaulic.
 - e. Zurn.
 - f. KITZ.
- 6. Thermostatic Mixing Valves:
 - a. Leonard.
 - b. Rada.
 - c. Lawler.

1.5 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets on all valves, strainers, unions, flanges, gaskets, water meters, and gauges and thermometers, clearly showing all rating, capacities, and features.
 - 2. Valve samples, when requested.
 - 3. Additional information as required in Section 23 01 00.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Store plumbing piping valves and accessories in their factory-furnished coverings, and in a clean, dry indoor space which provided protection against the weather.

PART 2 - PRODUCTS

2.1 MATERIALS:

Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for Human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372. Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.

2.2 VALVES

- A. General: All valves shall be similar to numbers listed. All similar type and size valves shall be products of one manufacturer.
- B. Applications: Valve application shall be as follows:

<u>Service</u>	<u>Application</u>	<u>Type</u>
Domestic Water	Shutoff	Ball
	Shutoff	Gate
	Balancing	Globe
	Check	Silent Check

- C. Pressure Ratings:

<u>Service</u>	<u>Location</u>	<u>Rating</u>
Domestic Water	All	Refer to Section 22 00 00

- D. Insulated Piping: Stems on all valves installed in insulated piping shall be extended to allow adequate clearance between the operator and the insulation specified for the piping system when the valve is installed.
- E. Flanges: Valve flanges and companion flanges for all valve applications shall be compatible with the valve rating and the system pressure at the point of application. Flanges shall conform to ANSI B16.1 and ANSI B16.10.
- F. General Requirements:

1. All valves shall be of threaded or flanged type. No solder connected valves on water lines shall be used on this project. All bronze and iron body gate and globe valves shall be of one manufacture for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.
2. All valves at system points where the System Working Pressure (SWP) at the point of application, including appropriate pump shutoff head, does not exceed 150 psi, may use Class 150 valves.
3. All bronze gate valves for pressures up to 150 psi shall be ASTM B62 composition bronze. Bronze valves for pressures above 150 psi shall be ASTM B61 steam bronze. All bronze valves shall be union or screw over bonnet, rising stem type with ASTM B99 alloy 651 or ASTM B371 alloy 694 or equal stem material.
4. All bronze ball valves for pressures up to 300 psi shall be ASTM B62 composition bronze or ASTM B584 alloy 844.
5. All iron body valves shall have the pressure containing parts constructed of ASTM A126 Class B cast iron. Stem material shall meet ASTM alloy 876 or ASTM 371 Alloy 876 silicon bronze or its equivalent. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting shall be provided on yoke cap for maintenance lubrication of the yoke bushing.
6. All valves shall be repackable, under pressure, with the valve in the full open position.
7. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron handwheels, except iron body valves 2-1/2" and larger which may have either malleable iron or ASTM A126 Class B, gray iron handwheels.
8. Packing for all valves shall be selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one year period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked at no expense to the Owner with a packing material selected by the Owner.

9. Valves located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 at Boss G to accommodate a drain valve.
- G. Plumbing Valves For Domestic Water Service at or Less Than 150 PSIG:
1. Ball Valves:
- a. Ball valves shall be two piece with a standard or full line size port chromium plated brass balls for domestic water, 316L stainless steel and stems and reinforced seats and stuffing box rings. All ball valves shall be designed to permit repacking while valve is in line. Valves shall be furnished with blowoutproof stems.
 - b. Ball valves 2" and smaller shall be threaded body bronze or brass valves of a **full or standard** port design. Valves shall be rated for 300 psi WOG and shall conform to Federal Specification WW-V-35B. Valves shall be:
 - 1) Apollo No. 77-100 Series.
 - 2) Crane No. 9032 Series .
 - 3) Nibco No. T-585 Series.
 - 4) Red and White No. 5044F Series.
 - 5) Stockham No. S-216-BR-R-T.
 - 6) Victaulic Style 722
 - 7) Milwaukee UBPA-475 Lead-free
2. Gate Valves:
- a. Valves 2-1/2" and larger shall be flanged bronze mounted Class 125 iron body, outside screw and yoke gate valves with bolted bonnets and solid wedges. Valves shall be rated for 200 psi WOG and shall conform to MSS SP-70 and shall be:
 - 1) Crane No. 465-1/2.
 - 2) Jenkins No. 651-C.
 - 3) Lunkenheimer No. 1430.
 - 4) Nibco No. F-617-0.
 - 5) Red and White No. 421.
 - 6) Stockham No. G-623.
 - 7) Walworth No. 8726-F..
 - 8) **Milwaukee 2885A**
3. Globe Valves:
- a. Globe valves 2" and smaller shall be 300 psi WOG rated, all bronze globe valves with renewable-regrindable stainless steel plug disk and seat ring, union bonnet, and threaded connections. Valves shall conform to MSS SP-70 and shall be:
 - 1) Crane No. 14-1/2-P.
 - 2) Jenkins No. 546-P.
 - 3) Lunkenheimer No. LQ-600-150.
 - 4) Nibco No. T-276-AP.
 - 5) Stockham No. B 29.
 - 6) Walworth No. 3237-P.
 - 7) **Milwaukee UP502 Lead Free**
 - b. Angle and Y-pattern globe valves corresponding to the standard globe valve models specified above may be used where more-suited to the installation location.
 - c. Valves 2-1/2" and larger shall be flanged bronze mounted Class 125 iron body, outside screw and yoke globe valves with bolted bonnets and renewable seat and disc. Valves shall be rated for 200 psi WOG and shall conform to MSS SP-85 and shall be:

- 1) Crane No. 351.
- 2) Jenkins No. 613-B.
- 3) Lunkenheimer No. 1123.
- 4) Nibco No. F-718-B.
- 5) Red and White No. 400.
- 6) Stockham No. G-512.
- 7) Walworth No. 8906-F.

4. Check Valves:

- a. Check valves 2" and smaller shall be Class 150 threaded bronze swing check valves with horizontal swing and replaceable discs. Valves shall be rated for 300 psi WOG and shall conform to MSS SP-80 and shall be:
 - 1) Crane No. 141.
 - 2) Jenkins No. 352-C.
 - 3) Lunkenheimer No. 230.
 - 4) Nibco No. T-433.
 - 5) Red and White No. 238.
 - 6) Stockham No. B-321..
 - 7) Milwaukee UP509 Lead Free
- b. Check valves 2-1/2" and larger shall be flanged bronze mounted Class 150 iron body swing check valves with bolted bonnets and renewable seat and disc. Valves shall be rated for 200 psi WOG and shall conform to MSS SP-71, Type 1 and shall be:
 - 1) Crane No. 373.
 - 2) Jenkins No. 624-C.
 - 3) Lunkenheimer No. 1790.
 - 4) Nibco No. F-918-B.
 - 5) Red and White No. 435.
 - 6) Stockham No. G-931.
 - 7) Walworth No. 8928-F.
 - 8) Milwaukee 2974A
- c. All swing check valves shall be installed in vertical piping only. Allow adequate pipe clearance to allow for proper valve operation.

H. Reduced Pressure Backflow Preventer: Backflow preventers up to 2" shall be bronze body reduced pressure principal type with strainer and inlet and outlet gate valves, Clayton Model RP-2 or an approved equal. Backflow preventers 2-1/2" and larger shall be all bronze or epoxy coated cast iron with strainer and inlet and outlet OS&Y gate valves, Clayton Model RP-1 or an approved equal.

I. Flanges: Valve flanges and companion flanges for all valve applications shall be compatible with the valve rating and the system pressure at the point of application.

J. Valves for Gas Service:

1. Valves 2-1/2" and smaller Ball Valves, UL-AGA approved refer to Paragraph 2.1/G.1.

2.3 STRAINERS:

A. General: Water strainers shall be as follows:

1. 150 psig Working Pressure: 150 psig working pressure, 2" and smaller, shall be Muessco No. 351 or equal, 200 pounds WOG, bronze body with perforated 20 mesh stainless steel screen with cleanout and screwed ends. 150 psig working pressure, 2-1/2 through 24", shall be Muessco No. 751 or equal, 150 pounds WOG, perforated stainless steel screen with 1/16"

perforations for sizes through 4", and 5/32" perforations for 5" and above, with blowdown connection, and Class 125 ANSI B16.1 flanged ends.

2. 300 psig Working Pressure: 300 psig working pressure, 2" and smaller, shall be Muessco No. 352 or equal, 400 pounds WOG, bronze body with perforated 20 mesh monel screen with cleanout and screwed ends. 300 psig working pressure, 2-1/2 to 24", shall be Muessco No. 752 or equal, 300 pounds WOG, perforated stainless steel screen with 1/16" perforations in sizes through 4", and 5/32" perforations for 5" and above, with blowdown connection, and Class 250 ANSI B16.5 flanges.

2.4 UNIONS:

- A. General: Provide in lines assembled with screwed and soldered fittings at points of connection to items of equipment and elsewhere as indicated or required to permit proper connections to be made or so that equipment may be removed. Unions shall also be provided in welded lines at the connections to items of equipment, where flanges are not provided.
 1. Unions in steel lines assembled with screwed fittings shall be malleable iron screwed pattern unions with bronze seats. Unions in copper or brass lines shall be all brass, threaded pattern unions. Where unions are required by the above in steel lines assembled by welding, they shall consist of two mating welding flanges.
 2. Dielectric unions shall be used at all junctures of dissimilar metals.
 3. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2-1/2" and larger shall be ground flange unions. Unions in copper lines shall be 125 pounds ground joint brass unions or 150 pounds brass flanges if required by the mating item of equipment. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.

2.5 FLANGES:

- A. General: All 125/150 pound and 250/300 pound ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or ASTM A-105-71 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges will not be acceptable. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forgings or materials will not be acceptable. The flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Submit data for firm certifying compliance with these Specifications. Gaskets used shall be ring form, dimensioned to fit accurately within the bolt circle, shall be 1/16" thick, Manville service sheet packing Style 60. Inside diameter shall conform to the nominal pipe size. Bolts used shall be carbon steel bolts with semifinished hexagon nuts of American Standard Heavy dimensions. All-thread rods will not be an acceptable for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi. Flat faced flanges shall be furnished where required to match flanges on pumps, check valves, strainers, and similar items. Only one manufacturer of weld flanges will be approved for each project.

2.6 GASKETS:

- A. General: Gaskets shall be placed between the flanges of all flange joints. Such gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16" thick Manville Service Sheet Packing Style 60. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.

2.7 FLEXIBLE CONNECTIONS:

- A. General: Refer to Section 15250, "Vibration Isolation", for flexible connections.

2.8 GAUGES:

- A. General: Provide gauges and thermometers for monitoring plumbing systems as shown on the Drawings and specified herein.
- B. Gauges: Gauges shall be Ashcroft, Terice, Weksler, Moeller, or U.S. with 4-1/2" dial face, phenol case, stainless steel movement with Grade A phosphor bronze bourdon tube and micrometer-type calibration adjustment screw. Accuracy shall be 1/2 of 1% of full scale. Provide a Crane No. 88 or equal needle valve gauge cock in pressure tube to gauge. Gradation shall be one pound or less.
- C. Range and Gradations: Gauges and thermometers shall be selected to give range and graduations best suited for quantities to be measured. Generally, gauges and thermometers shall be selected so that normal operating pressures and temperatures are not more than 2/3 nor less than 1/2 of the range; scale division shall be 2°F or less. Typical ranges for domestic cold water shall be 0°F to 100°F and for domestic hot water shall be 30°F to 240°F.
- D. Gauge Locations: Provide pressure gauges at the following locations:
 - 1. Suction side of each pump.
 - 2. Discharge side of each pump.
 - 3. **At the inlet and outlet of each water softener.**
 - 4. As shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Except as otherwise indicated, comply with the following requirements.
- B. Isolation Valves: Provide isolation valves in domestic water systems at each runout to a piece of equipment, each fixture, and elsewhere as shown on the Drawings.
- C. Valve Stems: Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane. All valves shall be located so as to make the removal of their bonnets possible. All flanged valves shown in the horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be made up with their valve stems inclined at an angle of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested for final acceptance. Valves shall be installed as nearly as possible in the locations as shown on and Drawings. Any change in valve location must be so indicated on the As-built Drawings.
- D. Swing Check Valves: Swing check valves shall be installed in horizontal piping only.
- E. Unions and Companion Flanges: Provide unions or companion flanges where required to facilitate dismantling of valves and equipment.
- F. Strainer Blowdown: Provide a blowdown valve with hose connection and cap at each strainer for blowdown.

3.2 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 10 10

SECTION 22 10 20

PLUMBING PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide complete operating plumbing piping systems including pipe, tube, fittings, and appurtenances as indicated and in compliance with these Specifications
- B. Plumbing Services: Secure all plumbing services necessary for the project as required or shown on the Contract Drawings, including paying all required fees and charges. Work related to plumbing services maybe shown on Plumbing, Civil, Architectural or other drawings in the Contract Documents
- C. The Division 23 Contractor shall be responsible for coordinating plumbing services and site utility work as shown on the Contract Drawings with the General Contractor to determine what work is included in the scope of the Division 23 Contractor.

1.3 QUALITY ASSURANCE:

- A. Welding: Qualify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and job site welding of piping work. Make welded joints on the piping system with continuous welds, without backing rings and with pipe ends beveled before welding. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no weld metal shall project inside the pipe. Refer to Section 15050 for additional requirements.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

- A. General: Provide pipe and tube of type, joint, grade, size, and weight (wall thickness, schedule or class) indicated for each service. Comply with applicable governing regulations and industry standards.
 - 1. Interior Soil and Waste Piping: Unless otherwise shown, interior soil and waste piping to a point 5 feet, zero inches outside the building exterior wall line shall be service weight cast iron bell and spigot piping, with joints made up with "Dual-Tite" or "Ty-Seal" neoprene gasketed joints. Above grade, service weight cast-iron plain end pipe, with joints made up with "No-Hub" coupling consisting of neoprene sleeve and stainless steel shield and clamps, torqued in accordance with manufacturer's recommendations. Mfg: Clamp all 125 or Husky SD 4000.
 - 2. Vent Piping: Provide service weight cast iron bell and spigot piping, with joints made up with "Dual-Tite" or "Ty-Seal" neoprene gasketed joints. Above grade, service weight cast-iron plain end pip, with joints made up with "No-Hub" coupling consisting of neoprene sleeve and stainless steel corrugated shield and clamps, torqued in accordance with manufacturer's recommendations.
 - 3. Storm Drain Piping: Provide piping similar to waste and soil piping specified hereinabove.
 - 4. Domestic Water Piping: Provide hard drawn copper tubing for all domestic water piping 3" and smaller, including cold water, hot water and recirculating lines. Joints shall be soldered with lead free wrought copper solder, ANSI B16.22 suitable for working pressure up to 250 psig. Cored

solder will not be allowed, all solder shall be solid string or wire type. Piping larger than 3" shall be cast iron with mechanical joints with appropriate gaskets, nuts and bolts.

5. Gas Piping: Provide standard weight black steel. All intermediate pressure pipe and all fittings 2" and larger shall have welded joints. Fittings 1-1/2" and smaller shall have standard weight black malleable iron screwed. Fittings 2" and larger shall have "Tube Turn" forged welding type, or approved equal.

2.2 PIPE/TUBE FITTINGS:

- A. General: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve, and equipment connections. Where not otherwise indicated, comply with governing regulations, industry standards, and where applicable, with pipe manufacturer's instructions for selections.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

- A. Industry Practices: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without failure or degradation of service. Install each run with a minimum of joints and couplings, but with adequate and accessible unions or flanged connections to permit disassembly for maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align accurately at connections, within 1/16" misalignment tolerance. Coordinate piping locations with other trades to avoid conflict. Give ductwork preference unless directed otherwise by the Engineer.
- B. Systems: Install piping parallel or perpendicular to lines of building, true to line and grade, and with sufficient hangers to prevent sags between hangers. Provide fittings at changes in direction. Piping in finished areas shall be concealed, except in mechanical rooms. Where pipes of different sizes join, provide reducing elbows, tees, or couplings. Bushings will not be acceptable.
- C. Pipe Layout: All piping shall be installed in accordance with Plans and Specifications and according to all applicable local and state codes. Minor piping revisions due to substituted equipment are acceptable provided they are indicated on piping fabrication drawings. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage or from laying on the ground shall be removed.
- D. Concealed and Exposed Piping: All piping in finished areas shall be concealed, unless otherwise noted. Piping exposed in mechanical rooms and other locations as noted shall be installed in an orderly manner and parallel with or perpendicular to building lines. Exposed piping in occupied areas shall be routed tight to the structure or as high as is possible.
- E. Expansion and Contraction: Install loops, offsets, sizing joints, and expansion joints, as necessary, to avoid strain resulting from expansion and contraction of piping systems on fixtures and equipment.
 1. Expansion Loops and Offsets: Provide expansion loops and offsets in piping systems for not less than one inch (1") expansion or contraction per 100' of pipe.
- F. Steel Pipe: Ream steel pipe after cutting and before threading. Thread with clean-cut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make-up. Use John Crane or approved equal teflon thread tape applied only to male threads to make-up joints.

- G. Copper Pipe: Cut copper pipe square and ream to remove burrs. Clean fitting socket and pipe ends with sand cloth, No. 00 cleaning pads or wire brush. No acids shall be used to clean either pipe or fittings or as a flux in sweating joints. The use of drilled T connections is not permitted.
- H. Final Connections to Equipment Furnished by Owner or Under Other Divisions of These Specifications: Where Drawings show equipment to be furnished under other Divisions of these Specifications or by the Owner, such equipment will be delivered to the site, uncrated, assembled, and set in-place under those other Divisions of these Specifications or under the separate contracts. Any required automatic control valves shall also be provided under those other Divisions of these Specifications or other separate contracts. Make all final connections of chilled water, hot water, condenser water, gas, domestic water, waste, and vent as shown. Provide valves, unions, strainers, check valves, and traps as required for proper operation of systems and equipment. Equipment not shown or noted on the piping drawings shall not be included in the scope of this requirement.
- I. Grading: All piping shall be carefully installed so as to eliminate traps and pockets in pressurized lines and to maintain flow in gravity flow lines. Where air pockets and traps cannot be avoided, provide valved hose connections for water traps and valved automatic air vents for air traps. The Contractor shall consider pipe grading requirements when coordinating pipe routing for the project. Pipe slope shall be maintained throughout the project. Waste and vent piping shall be sloped in accordance with the applicable codes. Pressurized plumbing piping systems shall be sloped to drain points.
- J. Pipe Grading: Install domestic water piping to pitch down in the direction of flow for drainage. Grade storm, soil, and waste piping at 1/4" per foot whenever possible, and not in any case less than 1/8" per foot for pipe sizes 4" and larger, unless shown otherwise on the Drawings. Grade vent piping at 1/4" per foot whenever possible, and not in any case less than 1/8" per foot toward vents. Grade gas piping at a minimum of 1/8" per foot toward condensation traps at connected equipment.
- K. Arrangement: Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment. All valves and specialties shall be placed to permit easy and proper operation and access, and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. Tapered reducers shall be used wherever changes in pipe sizes occur in mains. Bushings will not be permitted. The use of bull head tees or other high pressure drop configurations will not be permitted.
- L. Anchors: Pipe anchors shall be provided and installed at each end of piping runs which require expansion loops or joints, and where indicated on Drawings. Anchors shall be fabricated of rigid structured steel members firmly secured to the building structure.
- M. Protection: All open ends of pipes and equipment shall be properly capped or plugged during construction to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton, waste or similar materials are not acceptable.
- N. Pipe Sizes: If the size of the piping is not clearly evident in the Drawings, the Contractor shall request instruction as to the proper sizing.
- O. Make-up lead and oakum joints with molten lead run into hubs in one continuous pour, to a minimum depth of one inch (1").
- P. Make-up "Ty-Seal" or "Dual-Tite" gasketed joints using lubrication and joining tools as instructed by the manufacturers. Base of stacks, horizontal runs under pressure, and gasketed pipe 5" and larger shall be made up using "Lubrifast" joining material.
- Q. Torque "No-Hub" joints in accordance with manufacturer's instructions. Do not install "No-Hub" joints below ground.
- R. Provide chrome-plated piping at each fixture installed in a finished space. Install with proper strap wrenches to avoid marking or defacing.
- S. Provide proper restraints on riser and stack offsets.

3.2 DOMESTIC HOT AND COLD WATER PIPING SYSTEMS:

- A. Piping Runouts to Fixtures: Provide piping runouts to fixtures sized to comply with governing regulations. Where not otherwise indicated, provide runouts sized to comply with the following: lavatories - 1/2" hot, 1/2" cold; water closet flush valves - one and one half inch (1-1/2") cold; urinal flush valves - one inch (1") cold; drinking fountains - 1/2" cold. Provide each fixture with a shut-off valve for each supply line. All exposed lines shall be chromium-plated.
- B. Riser Air Chambers: At the top of each main hot and cold water riser, provide an air chamber two pipe sizes larger than riser pipe and 24" high.
- C. Fixture Air Chambers: At each hot and cold water supply pipe at each fixture, provide an air chamber the same size as the fixture branch and not less than 18" high.

3.3 STORM AND SANITARY DRAINAGE SYSTEM:

- A. Waste and Vent Piping Underground: All underground waste and vent piping, including turns to the vertical to 12" above the grade floor slab, shall be constructed of service weight (SV) hub and spigot cast iron soil pipe and fittings with **[lead and jute yarned] [or] [positive sealing elastomeric gasket joints.] [Lead and jute joints shall be yarned and then a continuous lead pour shall be made at least one inch (1") deep and caulked three times with tools properly sized for the pipe.] [Elastomeric gaskets shall be installed using an approved gasket lubricant.]** Pour concrete thrust blocks at all below grade turns and offsets for waste piping 6" and larger.
- B. [Vertical] Waste [and Vent] [Stacks] [and Waste] [Piping] Above Grade: Service weight (SV) cast iron pipe and fittings with positive sealing neoprene elastomeric compression type gasket joints. Elastomeric gaskets shall be installed using gasket lubricant. All horizontal stack offsets **[and elbows]** (4" and larger) shall be joint-strapped and supported using riser clamps and threaded rod.
- C. [Horizontal Fixture, Waste and] Vent [Manifolds] [Piping] Above Grade: Connect to the vertical stack with "No-Hub" cast iron soil pipe and fittings assembled with Stainless Steel No-Hub Coupling Assemblies.
- D. Building Storm Drainage Piping Underground: All underground horizontal Storm Water piping including turns to the vertical to 12" above the grade floor slab, shall be constructed of service weight (SV) hub and spigot cast iron soil pipe and fittings with **[lead and jute yarned] [or] [positive sealing neoprene gasket] joints. [Lead and jute joints shall be yarned and then a continuous lead pour shall be made at least one inch (1") deep and caulked three times with tools properly sized for the pipe.] [Elastomeric gaskets shall be installed using an approved gasket lubricant.]** Pour concrete thrust blocks at all below grade turns and offsets. The Building Storm Water System shall extend **[5'-0"]** outside the Building **[to a catch basin as shown on the Drawings]**.
- E. Building Storm Piping Above Grade: All Storm Drainage piping within the Building shall be service weight (SV) cast iron pipe and fittings with positive sealing neoprene elastomeric gasket joints. Elastomeric gaskets shall be installed using an approved gasket lubricant. All horizontal stack offsets **[and all elbows]** shall be joint-strapped and supported using riser clamps and threaded rod.
- F. Insulation: All condensate drains and related piping, roof drain[,], and overflow roof drain bodies and horizontal runs of storm drainage piping within the occupied spaces of the building, shall be insulated as specified in Section 23 07 00.
- G. Cleanouts: Install cleanouts at the base of every drainage stack, all bends and angles, upper terminal of each horizontal drainage pipe, each 90' length of horizontal straight run, where shown on the Drawings and as required by local code.
 - 1. Size: Cleanouts shall be line size for piping up to 4" and 4" size for piping larger than 4".
 - 2. Materials:
 - a. Unfinished area and chases provide J.R.Smith - 4013 cast iron with countersunk slotted head and lead seal plug with heavy duty loose set scoriated cast iron cover.

- b. Finished walls provide J.R.Smith 4435 cast iron with countersunk slotted head, lead seal plug, square smooth finish Nikalloy access cover, 6"X6", nickel brass frame with anchoring lugs.
- c. Finished floors provide J.R.Smith 4020, 4020-Y for carpeted areas, floor cleanout with adjustable extension housing, cast iron with lead seal plug, round top, access cover and round frame.

3. Access: Provide access doors for access to cleanouts installed in concealed locations.

H. Fixture Connections:

- 1. Water Closets: Galvanized castable nipples.
- 2. Urinals: Copper or cast iron nipples with suitable adapters.
- 3. Lavatories: Copper or cast iron nipples with suitable adapters.
- 4. Service Sinks: Brass or cast iron nipples with suitable adapters.
- 5. Drinking Fountains: Copper or cast iron nipples with suitable adapters.

3.4 NATURAL GAS PIPING SYSTEM:

- A. Code Compliance Products: Comply with local utility company and AGA regulations which require the products used for gas piping work to be selected from lists in certain published standards or coded as indicated.
- B. Gas Piping: Gas piping intended for operation at pressures of 5 psig or greater shall be ASTM A53, Schedule 40, black steel joined by Schedule 40, black welding fittings. Gas piping, 2-1/2" and smaller, intended for operation at pressures less than 5 psig shall be ASTM A53, Schedule 40, black steel joined by Class 150 socket weld fittings except that Class 150, banded, black malleable iron, threaded fittings may be used at valves and equipment connection. Gas piping, 3" pipe size and larger, intended for operation at pressures less than 5 psig shall be ASTM A53, Schedule 40, black steel joined by Schedule 40, black welding fittings. Provide condensation traps with removable caps at all equipment connections.
- C. Concealed Piping and Protection: Gas piping run concealed in walls, chases, or above ceilings shall be installed in a Schedule 20 welded steel sleeve vented to the outside atmosphere. Suitable internal spacers shall be provided. Inaccessible piping shall be all-welded connections. Socket type weld fittings may be used for sleeved gas piping.
- D. Underground Piping: Gas piping installed below grade shall be coated with Republic Steel Corporation (US) "X-Tru-Coat" high density polyethylene extruded coating, factory-applied with a fluid mastic to a minimum thickness of 0.040". Field welds, joints, and fittings shall be protected with mastic undercoat and by wrapping at least two layers of "X-Tru-Tape" installed as instructed by manufacturer.
- E. Gas Distribution System Drip Pipes: Drip pipes shall be provided throughout the gas piping systems for the purpose of accumulating moisture and condensate. They shall be sized no smaller than the gas main which they drain in each instance. These drip pipes shall be U-shaped providing an effective water seal of no less than 12" of water. The extremity of each U-shaped drip pipe shall be threaded and capped with a suitably sized, screwed pattern, black, standard weight, malleable iron cap. All drip pipes shall be located in an accessible position so that the condensate may either be pumped from the system or so that a water seal may be provided in the event that the water forming the seal evaporates.

3.5 FLOOR DRAINS:

- A. General: Provide floor drains as manufactured by Josam, J.R.Smith, Zurn or Wade. Refer to plans for schedule

3.6 ESCUTCHEON PLATES:

- A. General: Except as otherwise noted, provide chrome-plated brass floor and ceiling escutcheon plates around all pipes, and similar items passing exposed through walls, floors, or ceilings, in any finished spaces except under floor and attic spaces. Plates shall be sized to fit snugly against the outside of the conduit. Plates will not be required for piping where pipe sleeves extend above finished floor. Provide sheet metal trim plates at all penetrations exposed to view of building occupants, unless directed otherwise by the Architect.
- B. Type: Escutcheon plates shall be Dearborn Brass Company, Fig. No. 1149 through 1152.

3.7 PENETRATIONS, FLASHING, AND SEALS:

- A. Pipe sleeves, pitch pockets, and flashings compatible with the roofing and waterproofing installation shall be provided for all roof and wall penetrations and roof-mounted equipment and supports. Coordinate flashing details with the Architectural details and the roofing/waterproofing Contractors.
- B. Segmented Annular Seals: Seal the openings around piping which penetrate the exterior construction using segmented annular seals to prevent the entry of water and other foreign material. Segmented annular seals shall be Thunderline Corporation Type LS Series link seals or an approved equal. Seals shall be Style C insulating type for standard service at temperatures up to 250°F. Seals shall be Style T high temperature service at temperatures up to 450°F.

3.8 CLEANING, FLUSHING, TESTING AND INSPECTING:

- A. Cleaning: Clean exterior surfaces of installed piping systems and prepare surface for application of any required coatings.
- B. Piping Tests:
 - 1. General: Blank off equipment during tests. Perform tests before piping is enclosed in walls, floors, partitions or in any other way concealed from view. Tests may be performed in sections. Tests shall be witnessed by the Engineer or Owner's Representative and local inspectors and results presented to the Engineer for acceptance and approval prior to concealing piping from view. Provide all necessary equipment for testing, including pumps and gauges. Refer to Section 15020 for additional requirements.
 - 2. Domestic Water Systems: Test hot and cold water systems hydrostatically to a pressure of 150 psig or 1-1/2 times working pressure, whichever is greater, for a period of 24 hours. Repair all leaks, replacing materials as necessary, and repeat tests until systems are proven tight.
 - 3. Soil, Waste and Vent Piping System: Test soil, waste, and vent piping by plugging all openings and filling system to height required by City Plumbing Inspector, but not less than 10' above the level of the pipe being tested, for a minimum of 3 hours. Inspect all joints for leaks, repair all leaks found, and retest until piping is demonstrated to be free from leaks as evidenced by no perceptible lowering of the water level after 3 hours. In addition to water test, apply peppermint or smoke tests, if required by local code.
 - 4. Storm Drainage Piping System: Test storm drainage piping same as specified for Soil, Waste, and Vent Piping System.
 - 5. Natural Gas Piping System: Test natural gas piping with compressed air or nitrogen to a pressure of five times the expected service pressure, but not less than 100 psig, for a period of 24 hours. Repair all leaks, replacing materials as necessary, and repeat test until systems are proven absolutely tight. After all pneumatic testing of the entire gas piping system has been completed and all leaks have been repaired and at a time deemed suitable by the Owner's duly authorized representative, the Contractor shall have the gas supply turned on and the gas odorant chemical added by a representative of the gas company, as applicable. The Contractor shall then bleed gas from every riser and every runout until the odor of gas is present at every gas connection.
 - 6. Flushing: Flush water piping systems with clean water following successful testing.

- C. Disinfection of Water Systems: Disinfect hot and cold water systems as follows: Fill systems with water solution containing 50 ppm available chlorine; allow to stand for 8 hours, opening and closing all valves several times during this period; thoroughly flush; refill and place system in service; ensure a residual chlorine content of 0.2 ppm.
 - D. Cleaning and Adjusting: Thoroughly clean and disinfect all plumbing fixtures, including all exposed trim. Adjust all flush valves for proper flushing, but without excess use of water. Demonstrate to the Engineer that the entire plumbing system and all its components are functioning properly.
 - E. Inspecting: Visually inspect each run of each system for completion of joints, adequate hangers, supports, and inclusion of accessories and appurtenances.
- 3.9 IDENTIFICATION:
- A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 10 20

SECTION 22 12 00

ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide electric water heaters as specified, scheduled, and indicated.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products of the following:
 - 1. Rheem Mfg. Co., Water Heating Division.
 - 2. A. O. Smith, Corp.
 - 3. State Water Heaters.
 - 4. Bradford White, Corp.
- B. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters' Laboratories, Inc. (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.

1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets on water heaters with capacities, electrical characteristics, features and options clearly indicated.
 - 2. Control and power wiring diagrams, sequence of operation, safety controls and FM and UL labels and listings.
 - 3. Manufacturers recommended installation instructions for water heater.
 - 4. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver electric water heaters in factory-fabricated water-resistant wrapping.
- B. Handle electric water heaters carefully to avoid damage to material component, enclosure and finish.
- C. Store electric water heaters in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATERS:

- A. General: Provide electric water heaters of the size, capacities and characteristics scheduled and shown on the Drawings. Provide a three (3) year warranty for the entire unit.
- B. Elements: The heating elements shall be removable direct contact immersion type sealed in a zinc or tin-plated copper sheath or 80% nickel and 20% chromium sheath with a maximum density of 75 watts per square inch. Maximum size of individual heating element shall be 4.5 KW. Electric hot water

heaters shall have multiple elements, minimum two, and a total element quantity as required to meet the specified capacity. Elements shall be wired for non-simultaneous operation if capacity is less than 4.5 kW.

- C. Tanks: Heater shall be glass-lined steel tanks designed for a 150 psig working pressure and shall be vertical type. Heaters shall be factory insulated with polyurethane foam and jacketed. An arde rod and isolating inlet and outlet connections shall be provided for tank protection. A cold water dip tube shall be provided to replace water at the bottom of the tank
- D. Controls: Heaters shall be controlled with a thermostat through contactors if current requirements exceed thermostat capacity. Heaters shall have approved manual reset high limit thermostat to break all ungrounded conductors.
- E. Accessories: Heaters shall be complete with suitable stand, drain, ASME temperature and pressure safety relief valves, and other items as required. In addition, provide an external slip-on jacket insulation.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. General: Installer shall examine the conditions under which the water heaters are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

- A. General: Pipe and install water heaters as shown on the Drawings and in accordance with the manufacturer's written installation instructions. Water heaters shall be installed on a reinforced concrete housekeeping pad as specified in Section 15100, "Basic Materials and Methods", or be suspended with auxillary drain pan installed.
- B. Relief Piping: Provide a combination pressure and temperature relief valve (ANSI-21.22) and extend full size relief discharge piping from each water heater relief valve to the nearest floor drain or other approved point of safe discharge.
- C. Space Requirements: Furnished equipment shall fit in the space provided as shown on the Drawings. A floor plan layout of the equipment installation shall be included in the shop drawing submittal.
- D. Thermostat Adjustment: Adjust water heater thermostats to provide system water temperature as shown on the drawings.

3.3 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 12 00

SECTION 22 13 00

HOUSE/BREAK TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide house/break tanks as specified and indicated.
- B. Work of Other Sections: Electrical connections for high and low level alarms are specified in Division 16.

1.3 QUALITY ASSURANCE:

- A. The tank fabricator shall have had no less than 10 years experience building 3,500 gallon or larger potable water and fire protection water tanks for commercial construction and shall have previously constructed a minimum of 20 tanks of 3,500 gallons or larger. A list of installations of such tanks shall be furnished if required by the Engineer. The tank shall be constructed entirely of new material.
- B. Level alarm shall be UNIPOINT electrode system with control panel or an approved equal.
- C. Float operated valves shall be Cla-Val or an approved equal.

1.4 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Drawings to scale of all tank components indicating dimensions and locations of all pipe connections, ladders, manholes and stilling wells
 - 2. Certification of the design by a registered structural engineer
 - 3. Coating material specifications and product literature
 - 4. Accessory cut sheets showing all features, options and control diagrams.
 - 5. List of installations and year of placement into service
 - 6. Additional items as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. Deliver tanks, trim and accessories to the jobsite in a timely manner, coordinated with construction of the enclosing tank room. Cap, plug, cover and protect all tank openings.
- B. Handle tanks, trim and accessories carefully to avoid damage to material, component, enclosure and finish.
- C. Store tanks, trim and accessories in a clean dry space and protect from weather.

PART 2 - PRODUCTS

2.1 TANKS:

- A. General: Tank size and configuration shall be as shown on Drawings. Construction shall be in accordance with American Welding Society Specifications with steel plate and reinforcing as follows:
 - 1. 1/4" plate minimum for top.
 - 2. 1/4" plate minimum for shell sides, **divider**, and bottom.
 - 3. Four inch by 5.4 pound minimum channel reinforcing on top and six inch by 8.2 pound minimum channel reinforcing on sides.
 - 4. Flanged and threaded openings with vortex plates as shown on Drawings and required.
 - 5. Stainless Steel ladders inside and outside.
 - 6. 24" x 24" manholes with gasket cover in top and side of each compartment.

7. Perforated stilling wells for electrodes and float valves.
8. Split flange float access covers with neoprene rubber boots.
9. Tank vent with stainless steel vermin screen.
10. Tank overflow to sump with stainless steel vermin screen.
11. Valved drain connection(s) to sump.
12. Provisions for level alarm switches.
13. Lifting Lugs.
14. Nameplate.
15. Fire pump test connection, when required, with standpipe extending into the two tank two feet below the operating water level and with a baffle as detailed on the plans.
16. Water level gauge consisting of two one half inch angle valves with ball checks and ¼" needle drain valves, with 5/8" rigid plastic sight glass on each tank or compartment. The rigid plastic sight glass to be run inside continuous baked urethane coated Unitrust to provide physical protection.

B. Capacity: Tank capacities shall be as indicated on the Drawings plus 12" free space above the highest water level.

C. Water Tank Protective Coating:

1. Surface Preparation: In accordance with SSPC-SP10(63) near white blast clean with 2.0 to 3.0 mil surface profile.
2. Application: Confirm to standards of Steel Structures Painting Manual, Volume 1, Good painting Practice.
3. Interior Surfaces: One coat AMERLOCK 400 High SolidS Epoxy (buff) 4-6 mils and one coat AMERLOCK 400 (white). Final D.F.T. of 8-16 mils, and listed in ANSI/NSF Standard 61.
4. Exterior Surfaces: One coat of AEGEON 1112 VOC Phenolic Modified Red Iron Oxide Inhibitive Primer 1.5 to 3.0 mils D.F.T. on shell of tank[s]; two coats AEGEON 1400 Quick Dry Coal Tar Coating, 16-20 mils D.F.T. on top and bottom of tank[s].

D. Nameplate: A metal nameplate giving the name of fabricator, date of fabrication and serial number shall be permanently affixed to the tank.

2.2 ACCESSORIES:

- A. Solenoid Control Valve: Provide a 120 volt solenoid control valve on the city side of the surge tank fill valves as shown on the drawings. The valve shall be normally open and controlled by the high level alarm inside the surge tank. Closing of the control valve on fire water tanks shall signal the fire alarm system indicating that water flow has ceased to the fire system. Solenoid valves shall be Cla-Val Model No. 136G-03AB or an approved equal
- B. Float Valves For Each Water Compartment: Provide fill valves for each tank of the quantity and size shown on the drawings. Fill valves shall be Cla-Val No. 124G-01A or an approved equal, pilot operated diaphragm type float valves with brass float rods. Fill valve floats shall be furnished with suitable stilling wells. Valves shall have a brass housing with stainless steel and monel working parts, steel bracket and counterweight with non-corroding plastic float. Valves shall be hydraulically operated, diaphragm-actuated, globe pattern valves and shall contain a resilient, synthetic rubber disc, having a rectangular cross section, contained on 3-1/2 sides by a disc retainer and forming a tight seal against a single removable seat insert. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line. Valve shall open wide when float is at low liquid level and close driptight when float is at high liquid level. Settings shall be adjustable.

C. Unipoint Level Alarm System:

1. Level Alarm Signal Requirements: Provide electrode level alarm sensors with electrode fitting and level signal panel with all control relays, terminals, level sensing equipment, alarms, and all other apparatus and accessories specified or necessary for complete signal system. System to be the unit responsibility of one supplier.
 2. Provide the following and such other items as detailed on the drawings:
 - a. Electrode Fitting & Electrodes: Warrick Wire suspended electrode fitting[s], 3" flanged, series 3G for each tank or tank compartment- total of [] fitting[s].
 - b. Warrick type 3Z1A electrode suspensions wire as required with type 3W2SS wire suspended electrodes. One set of electrodes is required for each tank or tank compartment – total of [] set[s]. Provide arrangement of electrodes from top of tank as follows.
 - 1) High Level Alarm [and signal for block valve closure]
 - 2) High level reference.
 - 3) Low water alarm [and pump cut-off for domestic pump only].
 - 4) Low level reference [and provide a low level alarm output for monitoring by].
- D. Level Alarm Panel:
- 1) UNIPOINT alarm control panel, NEMA 4X fiberglass enclosure.
 - 2) Amber "Power ON" light.
 - 3) Warrick solid state electronic liquid level relay controls.
 - 4) Common alarm buzzer with silencing pushbutton.
 - 5) High & Low level alarm lights with name plate for each tank or tank compartment – total of [] light[s].
 - 6) Auxiliary alarm contacts for remote alarm device.
 - 7) Numbered terminal strip for field connections to electrodes, domestic pump circuit and remote alarm devices.
 - 8) Selector switch to select tank or compartments to be monitored. [Used where two compartments are provided for domestic and/or fire protection water].

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Pipe and install tanks as shown on the drawings and per the tank manufacturer's written installation recommendations.
- B. Housekeeping Pads: Install tanks on housekeeping pads as specified in Section 23 03 00. Bottom of tank shall be set in 1/8" thick coat of mastic covering the tank equipment pad.
- C. Painting: After installation, seal all exterior openings on the tanks, apply another coat of an approved zinc chromate primer and two coats of epoxy enamel.
- D. Startup: Thoroughly clean the inside of the tank and verify that all manhole doors and gaskets, vermin screens and float valve boots are installed before filling the tank.
- E. Alarms: Install tank alarm panels for wiring by Division 26.
- F. Testing: Test tank to verify proper operation of fill valves, high and low level switches, control interlocks and alarm annunciation.

END OF SECTION 22 13 00

SECTION 22 13 13

WATER TREATMENT EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

[EDIT TO SUIT PROJECT]

[ADD DEIONIZATION EQUIPMENT, IF REQUIRED]

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide potable cistern chlorination system, equipment and labor for testing, and dispensing products to control water quality in the cistern (approximately one million gallons storage capacity) and domestic water supply system as specified. All system components except chemical tank shall be unitized on a structural frame suitable for wall mounting in a corrosive environment. Include chemical feed pumps, piping, 4" flow header with flow switch, ejector with check valve, chlorine analyzer, measuring cell, measuring prefilter, wiring, controls, etc. All as required for a complete and functioning water treatment system.
- B. Chemicals: Provide, at no change in Contract amount, chemicals required for initial treatment of full cistern volume and testing water treatment systems prior to acceptance by the Owner.

1.3 QUALITY ASSURANCE:

- A. Packaging and Labeling: Supply water treatment chemicals in metal drums, fiber drums with plastic liners, or plastic lined "liqui-paks" as best suited to the materials. Paper bags or unlined cardboard cartons will not be acceptable. Use only chemicals in domestic water systems, and biocides, regardless of where used, shall be registered with the U.S. Department of Agriculture (USDA) or the U.S. Environmental Protection Agency (EPA) and labeled as required by law.
- B. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters' Laboratories, Inc. (UL) and comply with National Electrical Manufacturers' Association (NEMA) standards.
- C. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.
- D. Manufacturers:
1. Bob Johnson & Associates, Inc.
21606 Spring Bridge Road
Houston, Texas 77073
Telephone: (713) 443-2225
Fax: (713) 443-6831.

1.4 SUBMITTALS:

- A. Test Reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of treated water drawn from the domestic water pumping unit discharge. Comply with ASTM D596 for reporting. Indicate ASTM test methods used for each test.

- B. Shop Drawings: Submit Show Drawings for each water treatment system. Show wiring, piping and tubing sizes, fittings, accessories, valves, connections, and manufacturer's product data for all components.
- C. Instructions: Provide operation and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.
- D. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver water treatment products in factory-fabricated water-resistant wrapping.
- B. Handle water treatment products carefully to avoid damage to material component, enclosure and finish.
- C. Store water treatment products in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 POTABLE CISTERN WATER SYSTEM:

- A. General: Provide a complete factory-fabricated automatic potable cistern water treatment system designed to monitor, record, and control residual chlorine content.
- B. Chemical Feed Pumps: Provide two each piston diaphragm metering pumps (one online and one stand-by) as manufactured by Alldos or approved equal suitable for 120 volt operation. The pump shall have a maximum feed rate as required, and a maximum back pressure rating of 145 psi. The pump shall come with a double diaphragm for extra protection against damage and an audible alarm to sound when the pump is not working. The pump output will be adjusted manually and have a set point between 0% and 100% for stroke control. The pumps shall have PVC heads, an ejector with check valve, foot valve, and all necessary connections to the chemical storage tank. The pump shall be designed to handle up to a 30% solution of sodium hypochlorite.
- C. Chemical Storage Tank: The tank shall be a polyethylene storage tank with a bolt-down gasketed gastight cover. The cover will be equipped with gastight inlet and outlet vent connections. The tank shall come with graduated gallon markings on the side. A low level switch and alarm shall be provided and connected to the chemical feed pumps.
- D. Chlorine Analyzer: Provide an Alldos analyzer and indicator. The analyzer shall measure the chlorine level between zero and 2 PPM and come with a two point controller for minimum and maximum feed. Control cables for the analyzer shall be connected to the chemical feed pump(s) to turn the pump(s) on and off as required to maintain the set chlorine level within the cistern. The power supply available is 120 volt, 1-phase, 60 Hz to operate the analyzer.
- E. Measuring Cell: Provide an Alldos chlorine measuring cell in a glass bowl. The cell will be connected to the chlorine analyzer and operate on a 4-20MA power supply. The water from the recirculating line will pass by the measuring cell at a constant flow of 5 to 6 gallons per hour. The cell shall measure the chlorine level and send a 4-20MA signal to the analyzer. When the chlorine drops below the set point, the analyzer shall signal the chemical feed pumps to come on, and when the set point is reached the pumps shall turn off.
- F. Measuring Prefilter: A prefilter 10" in length shall be provided ahead and be installed in a clear polypropylene housing. The housing shall contain a 30 micron, 10" nominal polypropylene filter cartridge for sediment removal when the chlorine measuring cell requires calibration. An activated carbon filter shall be installed to remove the chlorine from the incoming water in order to calibrate the cell.
- G. Piping, fittings, and valves shall be made from Schedule 80 PVC or polypropylene.
- H. Install ejector, flow switch, and sampling water connection in the 4" PVC flow header.

- I. Mount all components on the unitized frame such that only the following connections are required:
 - 1. 120 volt single phase power supply.
 - 2. 4" flow header inlet.
 - 3. 4" flow header outlet.
 - 4. Flexible suction tube with foot valve inserted into tank.
 - 5. Discharge to drain.
- J. Controller enclosure shall be NEMA 4X and all interconnecting wiring shall be installed in PVC conduit as required. Control cabinet shall include analyzer, recorder, amplifier, operating lamps, alarm, safeties, controls, auxiliary contacts, etc., all as required for specified system operation. Chemical injection pumps shall be prevented from operating whenever the flow header mounted flow switch indicates a no-flow condition.

PART 3 - EXECUTION

3.1 POTABLE CISTERN WATER TREATMENT SYSTEM:

- A. General: Install potable cistern water treatment system where shown on the Drawings in accordance with manufacturers written instructions.
- B. Testing Equipment and Reagents: Furnish suitable water treatment testing equipment for each system, complete with apparatus and reagents necessary for operation until acceptance by the Owner.
- C. Initially treat full volume of cistern then verify system operation to maintain desired chlorine residual content of circulated water.

3.2 TESTING:

- A. Reports: Submit certified test report for each required water performance characteristic. Comply with following ASTM standards, where applicable:
 - 1. ASTM D859 - Tests for Silica in Water and Waste Water.
 - 2. ASTM D1067 - Tests for Acidity or Alkalinity of Water.
 - 3. ASTM D1068 - Tests for Iron in Water and Waste Water.
 - 4. ASTM D1126 - Tests for Hardness in Water.
 - 5. ASTM D1128 - Identification of Types of Microorganisms and Microscopic Matter in Water and Waste Water.
 - 6. ASTM D3370 - Sampling Water.

3.3 PERSONNEL TRAINING:

- A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water and condenser water treating systems, including preparation of chemical solution, if applicable, and charging of the chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems covered in this Section of the Specifications.

3.4 SERVICE REPRESENTATIVE:

- A. Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems, and tests required. Service representative shall return to the site bimonthly during the guarantee period. At such times, service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.

3.5 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 13 13

SECTION 22 14 00

DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 00 10, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide domestic water heaters as specified, scheduled, and indicated.
- B. Types: The types of domestic water heaters required for the project include, but are not limited to, the following:

[EDIT TO SUIT PROJECT]

- 1. Gas-fired water heaters.
- 2. Electric water heaters.
- 3. Steam-fired water heaters.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
 - 1. Pressure Vessels, Inc. (PVI).
 - 2. [Rheem Mfg. Co., Water Heating Division.]
 - 3. [AIRC0]
 - 4. [A. O. Smith, Corp.]
 - 5. [Armstrong]
 - 6. [State Water Heaters.]
 - 7. Adamson Company Inc.
 - 8. Bradford White, Corp.
- B. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters' Laboratories, Inc. (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.

1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets on water heaters with capacities, electrical characteristics, features and options clearly indicated.
 - 2. Control and power wiring diagrams, sequence of operation, safety controls and FM and UL labels and listings.
 - 3. Manufacturers recommended installation instructions for water heater.
 - 4. A floor plan layout showing water heaters installed in the space available on the Drawings.
 - 5. Additional information as required in Section 23 00 10.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver domestic water heaters in factory-fabricated water-resistant wrapping.
- B. Handle domestic water heaters carefully to avoid damage to material component, enclosure and finish.
- C. Store domestic water heaters in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

[SELECT TYPES TO SUIT PROJECT REQUIREMENTS]

2.1 GAS-FIRED WATER HEATERS:

- A. General: Provide gas-fired water heaters of the size and type with storage and recovery capacity as scheduled and shown on the Drawings. Each unit shall be a complete factory-fabricated and assembled package, including operating and safety controls. Each unit shall include an ASME pressure and temperature relief valve, temperature limiting device, and a drain valve. Each unit shall be Underwriters' Laboratories, Inc. approved and labeled.

[EDIT TANK LINING TO SUIT PROJECT]

- B. Tank: The tank shall be constructed in accordance with ASME Code, Section IV, and stamped with appropriate symbol for **[160 psi]** [_____ psi] working pressure. The tubes shall be covered with pure dead soft copper, expanded, beaded, and welded into the tube sheet. The interior tank surfaces shall be coated with Glashield, a thermosetting, polymerized fluorocarbon lining with high temperature resistance for long life qualities and rust free water. A 4" diameter handhole shall permit maintenance and inspection. Insulate heaters with heavy density fiberglass insulation and trimmed with a baked enamel steel jacket.
- C. Burner: Power burner shall be designed to operate with electrical power as scheduled or shown on Drawings. Motor shall be designed for continuous service with overload protection. Burner shall be designed so all components are outside the fire box for long life and ease of maintenance. It shall fire with a compact, swirling gas to burn more efficiently and release maximum Btu per volume of gas. A multivane blower shall supply precise amount of air for complete combustion. The burner shall be listed by Underwriters' Laboratories, Inc.
- D. Efficiency: The water heater shall have a minimum combustion efficiency of 80% and a standby heat loss not to exceed $2.3 + (67/V)$ as a percent of total Btus stored.
- E. Controls: Controls shall include a field-adjustable control to permit selection of hot water supply temperatures from 105°F to 160°F.
1. Solid state electronic programmer provides spark ignition to interrupted pilots with flame rod monitoring the main flame. Flame response time is 2 to 4 seconds. Precise sequencing provides prepurging of chamber, 10 seconds for proof of pilot, 15 seconds for proof of main burner, and 15 seconds post-purging of chamber. Automatic fluid power gas valve, manual main gas valve, pilot valve, and gas pressure regulator. A low water cut-off shall prevent unit operation upon sensing a low water status.
- F. Draft Regulator: Draft control shall be provided by heater manufacturer for installation in flue.
- G. Accessories: Factory-installed accessories shall include a redundant, high pressure protective device, a dial thermometer, and a dial pressure gauge.
- H. Warranty: Each water heater shall be provided with a full one year warranty, and a second through tenth year prorata tank warranty.

2.2 GAS-FIRED WATER HEATERS:

- A. General: Provide **[vertical]** **[horizontal]** gas turbine water heaters of the size and type with storage and recovery capacity as scheduled and shown on the Drawings. The heating section of each water heater shall be a single or dual module gas turbine burner and heat exchanger, capable of recovering the scheduled requirements at the scheduled difference in temperature using natural gas. The burner and heat exchanger assembly shall have a minimum start-up efficiency of 83%.

[EDIT TANK LINING TO SUIT PROJECT]

- B. Tank: The tank shall be constructed in accordance the ASME Code, Section IV and stamped with the appropriate symbol for **[125 psi]** [_____ psi] working pressure and registered with the National Board. The tank shall be of the capacity scheduled on the drawings and shall contain a strata-baffle to

divert the incoming cold water allowing draw efficiencies of up to 80% of the tank capacity. The tank shall be completely lined with chemically-deposited shield of electroless nickel to form a nonferrous, corrosion resistant barrier and then all interior surfaces of the shall be coated with three individual baked applications of Glashield, a high heat thermosetting polymerized fluorocarbon with highly water resistant qualities as protection against rust and corrosion. The tank shall be insulated with heavy density fiberglass insulation and trimmed with a baked enamel finish steel jacket with field replaceable panels.

- C. Heating Section: The entire heating section for each burner module shall have all heating surfaces completely surrounded by water with all nonferrous materials on the water side. Each burner module shall be a fully integrated heating section with cast aluminum sealed gas burner, combustion chamber, blower, fire tubes, flue gas outlet, gas train, **[FM] [IRI (FIA)]** approved burner controls and an efficiency indicator. The gas train shall include regulators suitable for connection at the gas supply pressure available at the water heater.
1. Burner controls shall include solid state electronic flame safeguard with programmed prepurge and postpurge of the fire chamber for all modules. All water heaters shall be provided with an electronic low water cutoff.
 2. An efficiency indicator shall sense flue temperature and shall have a green section (0°F to 400°F) to indicate normal operation, an amber section (401°F to 450°F) to indicate heat exchanger is ready for cleaning and a red section (451°F up) indicating excessive flue temperature. A switch interlock shall be provided to shutdown the burner module if the flue temperature exceed 500°F.
- D. Accessories: Water heater accessories shall include, but not be limited to, a solid brass drain valve, an ASME temperature and pressure relief valve, a 3-1/2" dial - 20°F to 200°F thermometer and a 3-1/2" dial - 0 to 200 psi pressure gauge.
- E. Warranty: Each water heater shall be provided with a full one year warranty and a second through tenth year prorata tank warranty.

2.3 ELECTRIC WATER HEATERS:

[INSERT TEXT FOR COMMERCIAL GRADE ELECTRIC WATER HEATERS]

[SEE SECTION 22 12 00 FOR SMALL POINT OF USE STORAGE WATER HEATERS]

2.4 STEAM-FIRED WATER HEATERS:

- A. General: Provide **[horizontal] [vertical]** steam-fired hot water heaters with dimensions and recovery and storage capacity as scheduled and shown on the Drawings. Specifications are provided for both copper and nickel lined tanks. Either construction will be acceptable for installation in this project, providing the generator conforms to the provisions of this specification. The manufacturers mentioned in this Specification or on the Drawings are listed for the purposes of indicating acceptable manufacturers, and establishing a standard of quality for the equipment to be provided for this project. The equipment as supplied by any of these acceptable manufacturers, or an approved equal, shall comply with all of the provisions of this specification.
- B. Vessel: The shell and heads of the vessel shall be constructed of ASME Code quality steel with all seams welded. The vessel shall be designed and fabricated for a minimum of **[125 pounds]** **[_____ pounds]** per square inch **[150 psi]** **[_____ psi]** working pressure, and hydrostatically tested to 150% of the working pressure in accordance with ASME Code and so inspected and stamped.
- C. Controls: There shall be a minimum of two operating thermostats. These operating controls should be set at **[120°F]** **[_____°F]** for the lower thermostat and **[130°F]** **[_____°F]** for the upper thermostat with a maximum circulating water temperature in the plumbing system not to exceed **[130°F]** **[_____°F]**. There shall be one temperature limiting device designed to prevent temperatures from exceeding a maximum of 200°F. There shall also be an ASME temperature and pressure relief valve set at not more than **[125 psi]** **[_____ psi]** and 205°F. A thermal expansion control valve shall be

installed in the cold section of the tank, set to relieve pressures of no greater than [100 psi]
[_____ psi].

- D. Insulation: The tank shall be painted using the manufacturer's standard paint system and insulated with high density fiberglass insulation and shall be jacketed with a minimum of 22 gauge aluminum sheet metal. Non-aluminum sheet jacketing shall be protected with a factory-baked enamel finish. The heat loss of the insulated tank shall not exceed 14 Btu/hr. per square foot of tank surface area at an ambient temperature of 65°F. The entire water heater shall rest on galvanized or baked enamel protected channel iron skids.
- E. Option A - Nickel Lined Tank: The nickel lined (plated) tank shall be constructed in accordance with ASME Code Section IV, stamped with the appropriate symbol, and hydrostatically tested at a minimum of 190 psi. The tank shall have a removable manway entry into the vessel with a minimum diameter of 23". The tank may be of modular design where more than one tank module will be required to meet the total gallon capacity, however the total space required shall not exceed the footprint shown in the Drawings, and the total tank capacity shall be as scheduled on the Drawings. The tank shall contain a baffle to divert the incoming cold water to allow 80% of the total tank storage to be effective at a usable temperature of within 5°F from the set point of the operating thermostats. All fittings shall be of Type K heavy copper, and shall be welded to the tank prior to the application of the nickel plating, and subsequent application of the nickel plating, and subsequent application of the polymer coating.
1. Lining: The tank shall be completely lined, inside and out, with 97% pure nickel. The method of applying the nickel shall be by non-electric, chemical deposition method, creating a holiday-free, nonferrous layer of nickel over the interior of the vessel. The nickel lined tank shall have an additional interior overcoat of an elastomeric, polymeric, hydrophobic cross-linked plastic to prevent any electrolysis that may develop within the plumbing system. Sacrificial anodes will not be required.
 2. Steam Heat Exchanger: The heat exchanger element shall have the capacity as scheduled or shown on the Drawings. The steam heat exchanger shall produce a minimum capacity as scheduled with the scheduled difference in temperature with 15 psi steam. This installation will be supplied with the quantity of steam scheduled or shown on the Drawings. The steam heat exchanger shall produce a minimum of 1300 Btu/°F/square foot of heating surface. All internal wetted parts shall be made of 9010 copper-nickel. The heat exchanger shall be complete with all required steam valves, traps, and controls so that only field steam and condensate connections are required.
 3. Manufacturer: Nickel lined generators shall be manufactured by PVI Industries, Fort Worth, Texas.
- F. Option B - Copper Lined Tank: Extra heavy copper silicon threaded or flanged openings shall be provided for inlet, outlet, drain, recirculation, relief valve, vacuum breaker, thermometer, pressure gauge and thermostat. One nominal 11" x 15" manhole shall be provided, having copper lined ring and cover. Nozzles and couplings may be ASTM SB466 alloy COA710 annealed (80-20 copper nickel). The vessel shall be lined with 3 pounds per square foot deoxidized electrolytic sheet copper, attached to the steel shell and to all fittings by inert gas shielded arc welding. Lining shall be installed so that stored water contacts only nonferrous metals, and is to be tested and proven free of leaks prior to shipment. The annulus between the tank shell and lining shall be pressurized to 1-1/2 psi and soap applied to all welded seams to test for leakage. The quantity of 1-1/2 vacuum breakers shall be as recommended and furnished by the tank manufacturer. All connections to the tank, whether just a fitting or pipe connection, shall be made with properly installed dielectric fittings.
1. Steam Heat Exchanger: The heat exchanger element shall have the capacity as scheduled or shown on the Drawings. The heating element shall consist of (1-1/2" OD x 16 gauge, horizontal tanks), seamless copper U-tubes expanded into a solid bronze tube sheet. Element head shall be cast iron. If heating element exceeds 2' in length, a solid bronze spacer plate shall be provided. If heating element length is 4' or longer, a solid bronze element support shall be provided. The heating element length shall be at least two-thirds of the length (horizontal) of the tank. The nozzle into which the element is inserted shall be constructed with neck portion of solid copper silicon to which the steel slip-on flange is welded. The heat exchanger shall be

complete with all required steam valves, traps and controls so that only field steam and condensate connections are required.

2. Manufacturer: Copper lined generators shall be manufactured by Adamson Company, Inc., East Palestine, Ohio.
- G. Accessories: Provide a lower operating thermostat, upper operating thermostat, ASME temperature and pressure relief valve, temperature limiting device, thermometer, drain valve and other factory-installed accessories as required.
- H. Tank Warranty: Generator tanks shall have a minimum of an 8 year warranty to protect the Owner against defects in material and workmanship, discolored water, or tank perforation due to erosion and corrosion. Should the tank or liner fail for any reason within the first eight full years after start-up, the manufacturer shall, at the Owner's option, pay for all repairs or replacement, including material, labor, incidental costs and freight. The tank warranty must be submitted with the total package submittals. The submission of any submittal with a warranty less than that described, or the absence of a warranty with the submittal, will be sufficient cause for complete submittal rejection.
- I. Heat Exchanger Warranty: The heat exchanger shall have a minimum of a 3 year warranty against material and workmanship, corrosion and erosion, thermal shock, and fouling. All material, labor, freight, and incidental expenses shall be the responsibility of the manufacturer, should the warranty be exercised. The heat exchanger warranty must be submitted with total package submittals. The submission of any warranty less than that described, or the absence of a warranty with the submittal, will be sufficient cause for complete submittal rejection.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. General: Installer shall examine the conditions under which the water heaters are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

- A. General: Pipe and install water heaters as shown on the Drawings and in accordance with the manufacturer's written installation instructions.
- B. Housekeeping Pads: Water heaters shall be installed on a reinforced concrete housekeeping pad as specified in Section 23 03 00.
- C. Relief Piping: Extend full size relief discharge piping from each water heater relief valve to the nearest floor drain or other approved point of safe discharge.
- D. Space Requirements: Furnished equipment shall fit in the space provided as shown on the Drawings. A floor plan layout of the equipment installation shall be included in the shop drawing submittal.
- E. Flue Piping: Provide draft regulator and recommended flue size to flue installer.
- F. Thermostat Adjustment: Adjust water heater thermostats to provide system water temperature as shown on the drawings.

3.3 START-UP, ADJUSTMENTS AND TRAINING:

- A. Startup: Water heater checkout, start-up and adjustment shall be performed by a representative of the equipment manufacturer. Refer to Section 23 05 93 for additional requirements.
- B. Training: Owner's operator training in water heater operation and maintenance procedures shall be performed by a representative of the equipment manufacturer. System Operating and Maintenance Manuals shall be available to the Owner's operator at the time of operator training. Refer to Section 23 00 10 for additional requirements.
- C. Operating Instructions: A complete set of operation instructions covering the installation, maintenance and operation of each water heater shall be furnished bound in booklet form in the Operating and Maintenance Manuals. Refer to Section 23 01 00 for additional requirements.

3.4 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 14 00

SECTION 22 20 00

LABORATORY AIR COMPRESSORS AND VACUUM PUMPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide laboratory air compression and pumping systems as specified, scheduled, and indicated.
- B. Types: The types of laboratory pumping systems required for the project include, but are not limited to, the following:
 - 1. Laboratory air compressors.
 - 2. Laboratory vacuum pumps.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
 - 1. Pumps:
 - a. Chemetron
 - b. Beacon Medical Products
 - c. Squire-Cogswell.
 - d. Busch.
 - e. AirtechSouth.
- B. Electrical Standards: Provide electric motors and products which have been listed and labeled by Underwriters' Laboratories, Inc. (UL) and comply with National Electrical Manufacturers' Association (NEMA) standards.

1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets on the following:
 - a. Laboratory Air compressor package, accessories, features, capacities, listings and all other features required to determine system characteristics.
 - b. Laboratory Vacuum pump package, accessories, features, capacities, listings and all other features required to determine system characteristics.
 - c. Controllers with all components and wiring diagrams.
 - d. Refrigerated Air Dryers.
 - e. [Bypass] [Discharge] Filters.]**
 - 2. Floor plan layout showing all system components in the space available on the drawings.
 - 3. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver pumping systems, controllers, and accessories in factory-fabricated water-resistant wrapping.
- B. Handle pumping systems, controllers, and accessories carefully to avoid damage to material component, enclosure, and finish.
- C. Store pumping systems, controllers, and accessories in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

[EDIT TO SUIT PROJECT]

2.1 LABORATORY AIR COMPRESSORS

- A. General: Provide a factory assembled packaged **[duplex] [triplex], [skid mounted] [horizontal receiver mounted]** oil-free **[reciprocating] [liquid-ring]** air compressor assembly with all required trim and components for a complete and operational system. **Where self-contained breathing apparatus or supplied breathing air is required**, the system shall be capable of providing revised Grade "D" air quality as specified by CGA standards. **Pre-approval for such equipment must be secured from EHLS**

[Select one of the following]

- B. Compressors: Air compressors shall be the oil-free reciprocating types. Compressors shall be vertical, air-cooled, non-lubricated type designed with a positive pressure compressed air seal to prevent migration of lubricating oil from the crankcase to the compression chamber.
 - 1. Each compressor shall be capable of SCFM inlet capacity at 50 PSIG minimum with high efficiency open drip-proof motors rated for HP, **[460]** V, 3 PH, 60 hz. Refer to Section 23 04 00 for additional motor requirements.
 - 2. Motor-compressor units shall be capable cycling at a maximum rate of 10 starts per hour and shall be pressure controlled for on/off cycling.]

[Or]

- C. Compressors: Air compressors shall be the oil-free, single-stage, positive-displacement, non-pulsating, liquid ring type. Compressors shall have enclosed rotors, conical porting to facilitate adjustment of internal clearances and single piece cast iron bodies.
 - 1. Each compressor shall be capable of SCFM inlet capacity at PSIG minimum and shall be flexible coupled to a high efficiency open drip-proof motors rated for HP, **[460]** V, 3 PH, 60 Hz. Refer to Section 23 04 00 for additional motor requirements.
 - 2. Motor-compressor units shall be capable cycling at a maximum rate of 10 starts per hour and shall be pressure controlled for on/off cycling.

[Use the following with liquid ring compressors]

- D. Compressor Cooling: Each compressor shall be cooled using a **[recirculated]** compressant seal water system including **[a heat exchanger and]** provisions for a **[1.0] []** gpm fresh water constant purge. **[Heat exchanger shall be of a tube and shell design and shall be sized for nominal [61°F] cooling water in the heat exchanger shell.]** The cooling system shall be completely factory piped and wired such that the only required field connections shall be cold water supply[,]
[and] drain[.] [and cooling water supply and return.] All required, isolation valves, control valves, controls, backflow preventers and other accessories shall be factory installed, piped, wired and tested. **[A separate manually valved [7.0] [] gpm once-through seal water system shall be provided for backup operation.]** A Clayton RP-2 or approved equal reduced pressure type backflow preventer

shall be provided on the inlet to the seal water supply system. A high temperature sensor shall be factory installed in each cooling water circuit and shall be factory wired to a terminal block in the compressor control panel for monitoring **[by _____.]**

- E. **Controller:** All electrical controls shall be furnished in a UL approved NEMA 1 control panel for sequential operation of the compressors and shall be **[factory mounted on the package] [wired for remote wall mounting]**.
1. Panel shall include:
 - a. **[2][3]** - Magnetic full voltage, non reversing (FVNR) magnetic motor starters with three phase overload protection.
 - b. **[3][4]** - Fused disconnect switches, one for each compressor and one for the control transformer.
 - c. **[2][3]** - Run time meters, one for each compressor.
 - d. Cam time alternator to automatically switch lead/lag operating sequence of the compressors.
 - e. Phase failure relay (Refer to Section 23 04 00).
 - f. Primary and secondary fused control power transformer.
 - g. **[2][3]** - HOA switches, one for each compressor.
 - h. **[2][3]** - Red running indicator lamps, one for each compressor.
 - i. Alarm indicator light and silenceable alarm with remote alarm contact for thermal overload (loss of cooling water flow) alarm. This alarm will be monitored by **[____.]**
 2. The control panel shall be designed for a single [480] Volt, 3 Phase 60 Hz input feeder. Control Power shall have a separate fused disconnect tapped off of the main input feeder such that the compressor disconnect switches do not disconnect control power.
- F. **Refrigerated Air Dryers:** Provide refrigerated type air dryers with capacities as scheduled on the drawings. **[Air dryers shall be piped in parallel with the air purifier for standby use and in series with the air purifier for aftercooling.]**
1. Each air dryer shall be as shown or required and the unit shall be furnished with an on-off power switch, power on light, high air temperature warning light, refrigerant suction pressure gauge, inlet air pressure gauge, outlet air pressure gauge, inlet air temperature gauge, outlet air temperature gauge, automatic drain with shut off valve, thermal protection for the compressor with automatic reset, low ambient fan control, a unit mounted disconnect switch and all controls required for automatic operation.
 2. The dryer installed for bypass use shall be standard air dryer with an air-to-air heat exchanger to reheat discharge air. The air purifier air dryer (aftercooler) shall be similar to a standard air dryer but shall not have an air-to-air heat exchanger and shall have a knob for external adjustments of discharge air temperature from 35°F to 70°F.
 3. Air dryer shall be a **[Hankison Series 80 or approved equal.]**
- G. **[Bypass Loop] [Discharge] Filters:** **[Provide a filtered air purifier bypass loop.]** The filters installed in the air [purifier bypass loop] [compressor discharge] shall consist of a Hankison 3100 Series or approved equal one micron absolute filter with auto drain and a Hankison Model 3801-2 or approved equal activated carbon absorbent filter. Hankison Model 3801-2 or approved equal differential pressure alarms shall be installed across each of the bypass loop filters for monitoring by **[_____]** Alarm pressure settings shall be set as recommended by the filter manufacturer. The absolute filter auto drain connection shall be piped to the nearest floor drain.]
- H. **Aftercooler:** Factory assembled Medical Air Compressor package shall include integral aircooled aftercoolers with 25°F CTD.]

- I. Accessories: Provide a weatherproof outside air intake filter/muffler for installation on the system intake. Provide the following accessories for each compressor: isolation valves, pressure relief valves, inlet and discharge check valves, regulators, pressure reducing valves, gauge glass and ball float valves, pressure switches, flow control valves, solenoid valves, strainers, shock arrestors, flexible connections, flow switches, gauges and other required accessories for a complete and fully functional and operational system.
- J. Air Tank: Provide a [] [gallon] [cubic foot] vertical galvanized 125 psi ASME air receiver suitable for [medical] [laboratory] air use and provided with suitable leg supports, automatic drain, tank level sight glass, ASME pressure relief valve and pressure gauges. Tank shall be factory mounted on the compressor skids and pre-piped.
- K. Factory Testing: The compressor manufacturer shall conduct factory tests to verify that the actual compressor performance is within 5 percent of the specified rating and that compressor power consumption does not exceed the nominal rating or the compressor horsepower nominal rating. Certified test data shall be included in the system Operating and Maintenance Manuals.
- L. Components: All components of the Laboratory Air Compressor System shall be furnished by a single supplier who shall provide a complete shop drawing package detailing all system components and with detailed system field installation drawings. The supplier shall certify that the system as provided meets all the requirements of NFPA 56F and 99.
- M. Testing, Start-up and Certification: The entire installation of the Laboratory Air Compressor System shall be checked out, tested, started up and certified by the system supplier. After checkout, testing and startup, the system supplier shall provide the Owner with a notarized letter certifying that the system is properly sized and installed and that the system is in proper working order and complies with all applicable requirements of NFPA 56F and 99. Refer to Section 23 05 3 for additional testing requirements.

2.2 LABORATORY VACUUM PUMPS

- A. General: Provide a factory assembled packaged [duplex] [triplex], [skid mounted] [horizontal receiver mounted] [rotary vane] [liquid ring] type vacuum pump assembly with all required trim and components for a complete and operational system. The entire system shall be capable of passing liquids and soft solids directly through the vacuum pumps to waste.

[select one of the following]

- B. Vacuum Pumps: Vacuum pumps shall be rotary positive displacement, direct drive, total oil recirculated, air cooled type with cast iron body, rotor and end plates. Fiber vanes shall be free sliding in the rotor to compensate for wear and shall be designed for long life operation.
 - 1. Pumps shall be single stage, multi-vane, rated for continuous duty, capable of operation at 29.3" Hg. The pump shall be equipped with a built-in exhaust filter to make exhaust air 99.9% oil-free, exhaust pressure gauge, inlet check valve, wire mesh inlet screen and full oil recirculation system with four stages of oil separation.
 - 2. Pumps shall run quietly, not to exceed 85 decibels when running and shall be capable of using any standard SAE 10W-30 non-detergent oil.
 - 3. Motor-pump units shall be capable of continuous operation or cycling at a maximum rate of 10 starts per hour and shall be vacuum pressure controlled for on/off cycling.
 - 4. Pumps shall be rated at minimum [] SCFM @ [19"] [20"] Hg. Motors shall be open drip-proof high efficiency [] HP, [460] V, 3 PH, 60 Hz. Refer to Section 23 04 00 for additional motor requirements.

[Or]

- C. Vacuum Pumps: Vacuum pumps shall be oil-free, single-stage, positive-displacement, non-pulsating, liquid ring type as scheduled. Pumps shall have enclosed rotors and single piece cast iron bodies.

1. Each pump shall be capable of a minimum of [] SCFM @ 20" Hg minimum shall be flexible coupled to a high efficiency open drip-proof rated for [] HP, **[460]** V, 3 PH, 60 Hz. Refer to Section 23 04 00 for additional motor requirements.
2. Motor-pump units shall be capable of continuous operation or cycling at a maximum rate of 10 starts per hour and shall be vacuum pressure controlled for on/off cycling.]

[Use the following with liquid ring compressors]

- D. Pump Cooling: Each pump shall be cooled using a **recirculated** compressant seal water system including [a heat exchanger and] provisions for a **[1.2]** [] gpm fresh water constant purge. **[Heat exchanger shall be of a tube and shell design and shall be sized for nominal [61°F] cooling water in the heat exchanger shell.]** The cooling system shall be completely factory piped and wired such that the only required field connections shall be cold water supply[,] **[and]** drain [.] **[and cooling water supply and return.]** All required, isolation valves, control valves, controls, backflow preventers and other accessories shall be factory installed, piped, wired and tested. **[A separate manually valved [12.0] [] gpm once-through seal water system shall be provided for backup operation.]** A Clayton RP-2 or approved equal reduced pressure type backflow preventer shall be provided on the inlet to the seal water supply system. A high temperature sensor shall be factory installed in each cooling water circuit and shall be factory wired to a terminal block in the pump control panel for monitoring **[by _____.]**
- E. Controller: All electrical controls shall be furnished in a UL approved NEMA 1 control panel for sequential operation of the compressors and shall be **[factory mounted on the package] [wired for remote wall mounting]**.
1. Panel shall include:
 - a. **[2][3]** - Magnetic full voltage, non-reversing (FVNR) motor starters with three phase overload protection.
 - b. **[3][4]** - Fused disconnect switches, one for each pump and one for the control transformer.
 - c. **[2][3]** - Run time meter, one for each vacuum pump.
 - d. A cam time alternator to automatically switch lead/lag operating sequence of the pumps.
 - e. A phase failure relay (Refer to Section 23 04 00).
 - f. Primary and secondary fused control power transformer.
 - g. **[2][3]** - HOA switches, one for each pump.
 - h. **[2][3]** - Red running indicator lamps, one for each pump.
 - i. Alarm indicator light and silenceable alarm with remote alarm contact for thermal overload (loss of cooling water flow) alarm. This alarm will be monitored by **[_____.]**
 2. The control panel shall be designed for a single **[480]** Volt, 3 Phase 60 Hz input feeder. Control Power shall have a separate fused disconnect tapped off of the main input feeder such that the compressor disconnect switches do not disconnect control power.
- F. Vacuum Tank: Provide a [] **[gallon] [cubic foot]** vertical galvanized 125 psi ASME vacuum receiver suitable for **[medical] [laboratory]** vacuum use and provided with tank drain valve, relief valve, gauge glass assembly and tank gauge.
- G. Accessories: Provide gauges, isolation valves, inlet check valves, sediment strainers, vacuum switches, flow control valves, solenoid valves, shock arrestors, antisiphon fittings, flexible connections, flow switches, discharge separators/ silencers and other required accessories for a complete and fully functional and operational system.
- H. Factory Testing: The pump manufacturer shall conduct factory tests to verify that the actual pump performance is within 5 percent of the specified rating and that pump power consumption does not

exceed the nominal rating or the pump horsepower nominal rating. Certified test data shall be included in the system Operating and Maintenance Manuals. Refer to Section 23 05 93.

- I. Components: All components of the Laboratory Vacuum Pump System shall be furnished by a single supplier who shall provide a complete shop drawings package detailing all system components and with detailed system field installation drawings. The supplier shall certify that the system as provided meets all the requirements of NFPA 99F.
- J. Testing, Start-up and Certification: The entire installation of the Laboratory Vacuum System shall be checked out, tested, started up and certified by the system supplier. After checkout, testing and startup, certifying that the system is properly sized and installed and that the system is in proper working order and complies with all applicable requirements of NFPA 99. Refer to Section 23 05 93 for additional testing requirements.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Installer shall examine conditions under which pumping are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- B. Installation: The systems shall be installed as shown on the drawings and in accordance with manufacturer's written instructions and detailed field installation drawings.
- C. Alignment: Check alignment and, where necessary, realign shafts of motors and pumps within tolerances recommended by manufacturer.
- D. Housekeeping Pads/Vibration Isolation: Refer to Section 23 03 00 and Section 23 05 48 for applicable requirements.
- E. Drain Lines: Provide drain lines (3/4" minimum) from each pumping system to the nearest floor drain.
- F. Cooling Water: **Coordinate cooling water connections to the system[.] [with the HVAC Subcontractor.]**
- G. Air Compressor Intake: The air compressor filter shall be located **[as shown on the Drawings] [a minimum of 3 feet above the roof level]**, a minimum of 25 feet away from sources of contamination and a minimum of 10 feet away from the other intakes.
- H. Vacuum Pump Discharge: The vacuum pump discharges shall be discharged through the roof and shall be turned down and screened to prevent entry of water, insects and foreign matter. The discharge outlet shall be located a minimum of 25 feet from any air intakes.

3.2 START-UP SERVICES:

- A. General: The pumping system supplier shall provide pump checkout, start-up, testing and adjusting of system components. The pump supplier shall also train the Owner's Engineer in the proper operation and maintenance of these pumping systems.
- B. Checkout: After pumps have been in operation for 90 days, the contractor shall check all seals and replace any which are defective.

3.3 TESTING:

- A. General: Test and adjust all installed laboratory pumps[.] **[and] controllers[, and annunciators]** to verify proper operation as specified herein and as recommended by the manufacturers. Where specified hereinabove, start-up, testing, and adjustment shall be provided by a representative of the equipment supplier.
- B. Functional Tests: Test pumps[.] **[and] controllers[, and annunciators]** to verify that all control, alarm and indicator functions operate properly and to verify that pump discharge pressures and flows are as specified.

C. Refer to Section 23 05 93 for additional start-up, testing, and adjustment requirements.

3.4 IDENTIFICATION:

A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 20 00

SECTION 22 30 00

PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide water conserving plumbing fixtures, trim, and accessories specified. Fixtures shall be complete with carriers, trim brass, flush valves, seats, stops, and other required accessories as specified herein or required. Trim for all sinks, lavatories, urinals, water closets, and showers shall comply with applicable water conservation standards.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable subject to compliance with the requirements of these Specifications

1. Fixtures:

- a. American Standard.
- b. Eljer Plumbing Ware
- c. Crane Company

2. Faucets and Accessories:

- a. American Standard
- b. PricePfister
- c. Crane
- d. T & S Brass and Bronze Works, Inc.
- e. Moen (kitchen faucets)
- f. Zurn (shower faucets)

3. Electronic Faucets

- a. Sloan
- b. Moen
- c. Toto

4. Flush Valves:

- a. Sloan Valve Company.
- b. Zurn Aquaflush Valves.
- c. Toto

5. Seats:

- a. Church Products, Forbes-Wright Ind., Inc.
- b. Olsonite Corporation.
- c. Beneke Corporation.
- d. Bemis.
- e. Zurn.

6. Carriers:

- a. Zurn Industries, Inc.
- b. J. R. Smith Mfg. Co.
- c. Wade Div./Tyler Pipe.

- d. Mifab.
- 7. Drinking Fountains:
 - a. Elkay Mfg. Company.
 - b. Sunroc.
 - c. Oasis Water Coolers
- 8. Stainless Steel Sinks:
 - a. Moen.
- 9. Emergency Showers:
 - a. Halsey Taylor - Div. Household Int. Co.
 - b. Bradley.
- 10. Hose Bibbs:
 - a. Chicago Faucet Company.
 - b. Woodford.
 - c. Zurn Industries, Inc.
- 11. Trim (Traps, Supplies, Stops, Etc.):
 - a. American Standard.
 - b. Eljer Plumbing Ware.
 - c. Kohler Company.
 - d. McGuire.
 - e. Zurn.
- 12. Residential Showerheads
 - a. Airjet FM chrome (281-859-9888)

1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Fixture, brass, trim, closet seat, flush valve, water cooler and carrier cut sheets showing all features, finishes and options.
 - 2. Additional items as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver plumbing fixtures and trim in factory-fabricated water resistant wrapping.
- B. Handle plumbing fixtures and trim carefully to avoid damage to material component, enclosure and finish.
- C. Store plumbing fixtures in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

[EDIT TO SUIT PROJECT]

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61, 01-01-14:

22 40 00 – 3, or
NSF 372.

Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.

2.2 WATER CLOSETS

- A. Water Closet (WC-_____): Wall hung flush valve, standard height, white vitreous china, elongated bowl, siphon jet, 1-1/2" top spud, **[polished] [brushed]** chrome Sloan Royal **[110-F-3 (11-1/2" rough-in)] [114-F-3 (24" rough-in)]** flush valve, Church [9500NSSC] [9400-KNSSC] white open front anatomical seat with self-sustaining and concealed check hinges.
1. Eljer No. 111-1405 "Auburn Watersaver".
 2. American Standard No. 2477.016 "Afwall".
 3. Crane:
- B. Water Closet WC-_____: Wall hung flush valve, standard height, white vitreous china, elongated bowl, siphon jet, 1-1/2" top spud, 1.6 gallon flush, **[polished] [brushed]** chrome Sloan Royal **[111 (11-1/2" rough-in)] [115-1.5 (24" rough-in)]** flush valve, Church 9500NSSC white open front anatomical seat with self-sustaining and concealed check hinges.
1. Eljer No. 111-1505 "Auburn Watersaver".
 2. American Standard No. 2257.103 "Afwall EL 1.6".
 3. Crane
- C. Water Closet (WC-_____): Wall hung, flush valve, handicapped mounting height, white vitreous china, elongated bowl, siphon jet, 1-1/2" top spud, **[polished] [brushed]** chrome Sloan Royal 110-F-3 (11-1/2" rough-in) flush valve, Church [9400-KNSSC] [9500NSSC] white open front anatomical seat with self-sustaining and concealed check hinges.
1. Eljer No. 111-1405 "Auburn Watersaver".
 2. American Standard No. 2477.016 "Afwall".
 3. Crane:
- D. Water Closet WC-_____: Wall hung, flush valve, handicapped mounting height, white vitreous china, elongated bowl, siphon jet, 1-1/2" top spud, 1.6 gallon flush, **[polished] [brushed]** chrome Sloan Royal 111 (11-1/2" rough-in) flush valve, Church 9400-KNSSC white open front anatomical seat with self-sustaining and concealed check hinges.
1. Eljer No. 111-1505 "Auburn Watersaver".
 2. American Standard No. 2257.103 "Afwall EL 1.6".
 3. Crane
- E. Water Closet (WC-_____): Floor mounted flush valve, standard height, white vitreous china, elongated bowl, siphon jet, 1-1/2" top spud, **[polished] [brushed]** chrome Sloan Royal **[110-F-3 (11-1/2" rough-in)] [114-F-3 (24" rough-in)]** flush-valve, Church [9500NSSC] [9400-KNSSC] white open front anatomical seat with self-sustaining and concealed check hinges.
1. Eljer No. 111-1115 "Sanus Watersaver".
 2. American Standard No. 2221.018 "Madera".
 3. Crane
- F. Water Closet (WC-_____): Floor mounted flush valve, handicapped height, white vitreous china, elongated bowl, siphon jet, 1-1/2" top spud, **[polished] [brushed]** chrome Sloan Royal 110-F-3 (11-1/2" rough-in) flush valve, Church [9400-KNSSC] [9500NSSC] white open front anatomical seat with self-sustaining and concealed check hinges.
1. Eljer No. 111-1245 "Hi-san Watersaver".
 2. American Standard No. 9468.018 "Elongated Cadet Watersaver".
 3. Crane
- G. Water Closet (WC-_____): Floor mounted, one piece, white vitreous china toilet, elongated siphon vortex action bowl. Solid plastic contour styled closed front seat with cover, **[polished] [brushed]** chrome 1/2" stop and supply and **[polished] [brushed]** chrome actuator button.

1. Eljer No. 081-1580 "Windsor".
2. American Standard No. 2009.017 "Roma".
3. Crane:

2.3 URINALS:

- A. Urinal (U_____): Texas ADA and ANSI A117.1 complying, wall hung flush valve, extended front, white vitreous china siphon jet, 1-1/4" top spud, 1 gallon flush, with integral flushing rim, integral trap and **[polished] [brushed]** chrome Sloan Royal 186-1-F flush valve.
1. Eljer No. 161-1190 "Bedfordshire".
 2. American Standard No. 6541-132 "Allbrook 1.0".
 3. Crane
- B. Urinal (U-_____): Wall hung flush valve, white vitreous china, blowout, 1-1/4" top spud, **[polished] [brushed]** chrome Sloan Royal 180-F flush valve.
1. Eljer No. 161-1100 "Terminal",
 2. American Standard No. 6570.014 "Jetbrook".
 3. Crane:
- C. Urinal (U-_____): Wall hung flush valve, white vitreous china blowout, 1-1/4" top spud, **[polished] [brushed]** chrome Sloan Royal 180-F flush valve.
1. Eljer No. 161-1060 "Correcto".
 2. American Standard No. 6531.019 "Lynbrook".
 3. Crane
- D. Urinal (U-_____): Wall hung flush valve, extended front, white vitreous china siphon jet, 1-1/4" top spud, with integral flushing rim, integral trap and **[polished] [brushed]** chrome Sloan Royal 180-1.5-F flush valve.
1. Eljer No. 161-1160 "Dover".
 2. American Standard No. 6540.017 "Allbrook".
 3. Crane

2.4 LAVATORIES:

- A. Lavatory (L-_____): Undercounter mounted, white vitreous china fixture, support clips for under counter mounting, American Standard No. 0470.039 "Ovalyn", 8" centerset **brushed** chrome faucet with **4" wrist blade** handles, 2 gpm flow restrictor, **[polished] [brushed]** chrome grid strainer drain/tailpiece assembly, stops and trap.
1. Eljer No. 051-3390 "Barrow".
 2. Kohler No. K-2210 19" x 15" "Caxton".
- B. Lavatory (L-_____): White vitreous china lavatory, front overflow, concealed arms American Standard No. 0194.076 "Roxalyn", 8" centerset **[polished] [brushed]** chrome faucet, with **4" wrist blade** handles, 2 gpm flow restrictor, **[polished] [brushed]** chrome grid strainer drain/ tailpiece assembly, stops and trap. **[Refer to Architectural Drawings for chrome wall spacers.]**
1. Eljer No. 051-2548 "Mayburne".
 2. Kohler No. K-2053 "Jamestown".
- C. Lavatory (L-_____): Countermounted, white enameled cast iron fixture, self-rimming, American Standard No. 3302.015 "Oval Horizon", 8" centerset **brushed** chrome faucet with **4" wrist blade** handles, 2 gpm flow restrictor, **[polished] [brushed]** chrome grid strainer drain/tailpiece assembly, stop and trap.
1. Eljer No. 052-0278 "Edwin".
 2. Kohler No. K-2905 "Farmington".

- D. Lavatory (L-): Refer to Architectural specifications for lavatory top and bowl. 8" centerset **brushed** chrome faucet with 4" wrist blade handles, 2 gpm flow restrictor, **[polished] [brushed]** chrome grid strainer drain/wheelchair offset drain assembly, stops and trap.
- E. Lavatory (L-): Refer to Architectural specifications for lavatory top and bowl. 8" centerset **brushed** chrome faucet, with wrist blade handles, **[polished] [brushed]** chrome pop-up drain/wheelchair offset assembly, stops and trap.

2.5 SINKS:

- A. Coffee Bar Sink (SK-): 15" x 15" nominal size, Type 302 stainless steel, 18 gauge, brush finish bowl; chrome gooseneck faucet, **[polished] [brushed]** chrome crumb cup strainer drain/tail piece, stops and trap.
- B. Single Compartment Sink (SK-): 19" x 18" overall 18 gauge stainless steel self-rimming sink, 7-1/2" deep, sound dampened brush finish bowl. **Brushed** chrome 8" centerset faucet with swivel goose-neck spout, 4" wrist blade handles, 2 gpm flow restrictor, Elkay LK-99 **[polished] [brushed]** stainless steel grid strainer, drain/tailpiece, stops and trap.
- C. Two-Compartment Sink (SK-): 29" x 18" overall, 18 gauge stainless steel self-rimming sink, 7-1/2" deep bowls, sound deadened and with satin finish, **Brushed** chrome 8" centerset faucet with swivel gooseneck spout, 4" wrist blade handles, 2 gpm flow restrictor, Elkay LK-99 **[polished] [brushed]** stainless steel grid strainer, drain/tailpiece, stops and traps.

2.6 ELECTRIC DRINKING FOUNTAINS:

- A. Electric Drinking Fountain (EDF-): Fully recessed, all stainless steel with capacity to furnish 8 gph of 50°F of water at 90°F ambient temperature using 1/5 hp, 120 volt, 1 phase, 60 Hz motor, with mounting frame.
1. Elkay No. EFRC-8.
- B. Electric Drinking Fountain Cooler (EDF-): Wall hung, surface mounted, all stainless steel, capacity to furnish 8 gpm of 50°F water at 90°F ambient temperature using 1/5 hp, 120 volt, 1 phase, 60 Hz motor.
1. Elkay No. ESWA-8-S - All stainless steel.
- C. Electric Drinking Fountain (EDF-): Surface mounted, all stainless steel with capacity to furnish 8 gph of 50°F water at 90°F ambient temperature using 1/5 hp, 120 volt, 1 phase, 60 Hz motor.
1. Elkay No. EWCA-8-S.
- D. Electric Drinking Fountain (EDF-): Wall-hung, semi-recessed, barrier-free dual height round bowl cooler, all stainless steel with concealed trap and stop and integral chilling system capacity to furnish 8 gph of 50°F water at 90°F ambient temperature using a 1/5 hp, 120 volt, 1 phase, 60 Hz motor.
1. Elkay No. ERPBM28K.

2.7 DRINKING FOUNTAINS:

- A. Drinking Fountain (DF-): Wall hung, semi-recessed, all stainless steel, barrier-free dual height round bowl type with stop and trap.
1. Elkay No. EDFP-117-C (Basis of Design)
 2. Sunroc
 3. Oasis

2.8 DRINKING WATER CHILLER UNIT:

- A. Drinking Water Chiller Unit (DWCU-): Packaged drinking water chiller with integral **[6] [30]** gallon storage tank and recirculating pump. Condensing unit shall be air cooled hermetic with dehydrator, adjustable thermostat and manual starter. Cooling tank shall be welded stainless steel with internal copper evaporator coil. Recirculating pump shall be bronze fitted and provided with an internal bypass valve. Unit shall produce **[15] [35]** gph of 50°F water using a **[one half] [one]** horsepower compressor and a **[1/25] [1/3]** hp recirculating pump with a single 120 volt, 60 Hz, 1-phase, **[20] [40]** ampere

power feed. **[The unit shall include a factory-wired 7-day dial electronic time switch to control hours of operation.]** The complete unit shall be factory-assembled in a painted steel cabinet with angle iron frame, suitable for wall mounting. Filtrine Model **[M-6-BWPA] [M-30-BWP]** or approved equal.

2.9 SERVICE SINKS:

- A. Service Sink (SS-_____): Stern-Williams No. SB 300 Series, "Serviceptor" 36" x 24" x 12" mop service basin with stainless steel cap, tiling flanges as required, 12" high, 20 gauge, Type 304 stainless steel splash guard on all adjacent wall surfaces, and a cast brass drain with nickel bronze strainer cast integral for 3" pipe connection. Speakman No. SC-5811-RCP, chrome-plated combination service sink faucet with vacuum breaker, 3/4" hose thread spout, four arm handles, wall brace, pail hook, rigid spout and integral stops. Provide 12" high, 20 gauge type 304 stainless steel splash guards on all walls adjacent to the service sink. Provide and install internal wall supports in accordance with the Architects requirements for the wall brace attachment. **[Provide Model T-35 36" hose with 3/4" chrome hose connections and stainless steel wall bracket and Model T-40 24" long stainless steel mop hanger with three spring loaded grips.]**
- B. Service Sink (SS-_____): Stern-Williams No. SB 900 Series, "Serviceptor" 24" x 24" x 12" mop service basin with stainless steel cap, tiling flanges as required, 12" high, 20 gauge, Type 304 stainless steel splash guard on all adjacent walls, and a cast brass drain with nickel bronze strainer cast integral for 3" pipe connection. Speakman No. SC-5811-RCP, chrome-plated combination service sink faucet with vacuum breaker, 3/4" hose thread spout, four arm handles, wall brace, pail hook, rigid spout and integral stops. Provide 12" high, 20 gauge type 304 stainless steel splash guards on all walls adjacent to the service sink. Provide and install internal wall supports in accordance with the Architects requirements for the wall brace attachment. **[Provide Model T-35 36" hose with 3/4" chrome hose connections and stainless steel wall bracket and Model T-40 24" long stainless steel mop hanger with three spring loaded grips.]**
- C. Mop Sink (MS-_____): American Standard #7740.020 Florwell or approved equal service sink with 3" outlet, acid resistant, enameled cast iron. Removable vinyl-coated rim guard #7745.011. American Standard No. 8344.111 faucet with top brace stops with vacuum breaker, brass 4-arm handles, 3/4" hose outlet and chrome finish. Provide 12" high, 20 gauge type 304 stainless steel splash guards on all walls adjacent to the service sink. Provide and install internal wall supports in accordance with the Architects requirements for the wall brace attachment.
- D. Janitor Sink (JS-_____): Fiat precast terrazzo basin Model TSBC-6010 with tiling flange and stainless steel caps, No. 1453-BB 3" 16 gauge drain Type 302 stainless steel flat strainer, E-77-AA rigid vinyl bumper guard, Speakman SC-5811-USA chrome-plated combination service sink faucet with bucket hook and wall brace, check stops, vacuum breaker and hose-end spout. Provide and install internal wall supports in accordance with the Architects requirements for the wall brace attachment. Provide and install internal wall supports in accordance with the Architects requirements for the wall brace attachment.

2.10 HOSE BIBS AND WALL HYDRANTS:

- A. Hose Bibb, (HB-_____) Interior: Chrome-plated surface wall hydrant with hardened stainless steel interior parts, chrome-plated vacuum breaker and loose operating key. Hydrant shall be Woodford No. 24 or an approved equal.
- B. Hose Bibb, (HB-_____) Interior or Moderate Climate Exterior: Enclosed flush wall hydrant with hardened stainless steel interior parts, brass chrome plated box face and hinged cover with operating key lock and operating key. Hydrant shall be Woodford No. **B74 Series with vacuum breaker** or an approved equal.
- C. Hose Bibb, (HB-_____) Exterior Wall, Nonfreeze: Enclosed flush, anti-contamination wall hydrant with vacuum breaker, hardened stainless steel interior parts, brass chrome plated box face and hinged cover with operating key lock, operating key and non-freeze valve. Hydrant shall be Woodford No. **B65 Series with vacuum breaker** or an approved equal.
- D. Hose Bibb, (HB-_____) Exterior Floor or Grade, Nonfreeze: Enclosed flush grade or floor hydrant with hardened stainless steel interior parts, 2'bury depth, non-freeze valve, and chrome plated brass box

face and hinged cover, operating key lock and operating key. Hydrant shall be Woodford No **Y95 with vacuum breaker** or an approved equal.

- E. Hose Bibb (HB-_____) Hot and Cold Water Mixer: Automatic draining freeze-less wall hydrant with vacuum breaker backflow preventer enclosed in a chrome plated brass wall box with hardener stainless steel interior parts, operating key lock and operating key. Hydrant shall be Woodford No. HCB65 or an approved equal.

2.11 SHOWERS:

- A. Shower (SH-_____): Cast brass valve body, ceramic disc valve cartridge, polished chrome, lever handle, pressure balanced shower valve with shower head and arm as specified. Provide with integral check valve stops and Type **[FD-1]** floor drain. Refer to Architectural drawings and specifications for shower pan and enclosure.
- a. American Standard
 - b. Price Pfister
 - c. Zurn

2.12 EMERGENCY SHOWERS:

- A. Emergency Shower (ES-_____): Bradley free-standing shower and eye/face wash, complete with deluge shower head, one inch (1") chrome-plated brass NPT stay-open ball valve actuated by stainless steel pull rod and ring, barrier-free design, high-performance corrosion-resistant stainless steel showerhead, floor flange, and interconnecting fittings. Unit shall be securely anchored to wall and floor.
- B. Emergency Shower/Eyewash (ES-_____): Haws No. 8308 stay-open ball valve emergency shower with foot treadle/push flag operated eye wash station and emergency sign. Chrome, painted galvanized and stainless steel construction.
- C. Emergency Eye Wash (EW-_____): Western Emergency Equipment Model No. 906, hand held eye/face wash with 12' recoiling hose, squeeze type valve, chrome plated brass spray head.

2.13 UNDERCOUNTER WATER HEATERS:

- A. Water Heater (WH-_____): Self-contained, point of use type, **[0.3] [0.5]** gpm, **[32°F] [40°F] [52°F] [63°F] [68°F] [105°F]** temperature rise, **[2300] [3000] [4600]** watts, **[120] [208]** volts, Chronomite Laboratories, Inc. No. S-**[23] [30] [46]** L/**[110] [208]** volt. Provide served faucet with a **[0.3] [0.5]** gpm flow restrictor.

2.14 FIXTURE CARRIERS:

- A. All wall-hung plumbing fixtures shall be supported from floor-mounted and bolted carriers. No wall-hung water closet, lavatory, urinal, drinking fountain or sink shall depend upon its support from the vertical building system.
- B. All fixture carriers in the building shall be the product of one manufacturer unless otherwise noted on the Drawings. In special instances and with the approval of the Engineer the foregoing may be waived in order to meet special building conditions.
- C. Carriers for wall-hung water closets shall be adjustable.
- D. Carriers for wall-hung lavatories shall be concealed and be constructed of rectangular steel. **[Carriers shall be suitable for use with chrome spacers where detailed on the Architectural Drawings.]**

2.15 PROHIBITED LABELS AND IDENTIFICATION:

- A. In all public [and tenant] areas of the project, fixtures or accessories with markings or insignias intended to identify the manufacturer, vendor, or source must be out of plain view. It is strictly prohibited for installation of any fixture or accessory which bears evidence that markings or insignias have been removed to meet this requirement. Certification, testing, and approval labels are exceptions to this requirement.]

2.16 EXPOSED PIPING:

- A. All exposed piping for supply waste and vent connections to plumbing fixture and connected equipment in finished areas shall be polished chrome-plated unless noted otherwise on the Drawings. This shall include piping, fittings, and valves. Polished chrome-plated sleeves may be used over supply, waste, and vent piping provided that the finished installation presents the appearance of a fully chrome-plated system.

2.17 FIXTURE TRIM:

- A. General: Trim shall be furnished as required for all fixtures.
- B. Faucet Trim: Trim shall be constructed of all metal exposed components. All trim components on the pressure side of the faucet valves shall be metal construction.
- C. Stops, Supplies and Traps: All stop valves shall be loose key. All risers shall be flexible smooth tube type with flare connections. All P-traps shall be adjustable and have cleanout plugs. All stops, supplies, and traps shall have a finish to match the fixture brass.
- D. Adjustable Cast Brass "P" Trap with Clean Out Plug:
1. 1-1/4" x 1-1/4": Eljer 804-1100
Kohler K-9004
McGuire 8088
 2. 1-1/4" x 1-1/2": Eljer 804-1105
Kohler K-9004
McGuire 8090
 3. 1-1/2" x 1-1/2": Eljer 804-1110
Kohler K-9004
McGuire 8089
- E. Closet Supply-Loose Key:
1. Eljer 802-0325
 2. Kohler K-7639
 3. McGuire H-2169-LK
- F. Lavatory and Sink Supply-Loose Key:
1. Eljer 802-0325
 2. Kohler K-7607
 3. McGuire H-2165-LK
- G. Offset Drain Assembly for [Handicapped] [all] Lavatories:
1. Eljer 803-530
 2. Kohler K-13885
 3. McGuire 155-WC

2.18 TRAP PRIMING PROVISIONS:

- A. General: Provide **[flush valves and lavatory traps with diverter fittings for trap priming] [Trap Guard]** where shown or noted on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Install and adjust all fixtures in accordance with manufacturers written instructions.
- B. Heights: Installation heights shall be specified in Section 15100 or shown on the Architectural Drawings.
- C. Carriers: All wall hung fixtures shall have floor-mounted carriers.
- D. Fixture Setting: Opening between fixture and floor/wall finish shall not exceed 1/8" and shall be caulked with **[white]** silicone caulk. Urinal and water closet sealing rings shall be resilient rubber. Wax sealing rings will not be acceptable.

- E. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls, etc., with brass through bolts, toggle bolts, expansion bolts, or power set fasteners, as required. Exposed heads of bolts and nuts in finished rooms to be hexagonal, polished chromium-plated brass with rounded tops.
- F. Protection: Tightly cover and protect fixtures and trim from damage during construction. Replace any components which are damaged prior to Project Acceptance.
- G. Cleaning: At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.
- H. Adjustment: Flush valves and other flow control devices shall be adjusted for proper operation prior to Project Acceptance.
- I. Keys: Provide all loose stop and hose bibb keys to the Owner at Project Acceptance.
- J. Insulation: Refer to Section 23 07 00 for insulation of **[handicapped] [all exposed]** lavatory traps, tailpieces and hot and cold water supplies.

END OF SECTION 22 30 00

SECTION 22 31 00

DOMESTIC WATER SOFTENERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide domestic water softeners as specified, scheduled, and indicated.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by Bruner or Rain Soft.

1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets on all equipment showing features, characteristics, and capacities.
 - 2. Water analysis results.
 - 3. Floor plan layout showing equipment layout in floor space which is available.
 - 4. Manufacturers recommended installation instructions for system.
 - 5. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver water softeners and accessories in factory-fabricated water-resistant wrapping.
- B. Handle water softeners and accessories carefully to avoid damage to material component, enclosure, and finish.
- C. Store water softeners and accessories in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER SOFTENER:

- A. General: Provide domestic water softening systems as shown on the drawings and as specified herein.
- B. Type/Capacity: The water softener shall be a twin, parallel softener tank unit with each tank capable of removing [] grains (per regeneration) of hardness from water as available at the site to not more than 0.3 grain per gallon of hardness as determined by an ASTM standard soap test method when operated at an intermittent capacity of [] **gpm** and a peak capacity of [] **gpm**. Pressure drop shall not exceed 15 psi at a flow rate of [] **gpm** and 25 psi at a flow rate of [] **gpm**. The system shall be capable of operating with inlet water temperatures from 40°F to 120°F and at inlet pressures from 30 psi to 120 psi.
- C. Water Analysis: The water softener supplier shall perform a water analysis on a water sample from the site water service to confirm the capacity of the selected equipment. If a significant variation in required equipment is found, notify the Architect/Engineer in writing prior to fabrication or ordering of equipment.
- D. Softener Tanks:
 - 1. The softener tanks shall be designed for a working pressure of [120 psig] [] **psig**, ASME Code construction of [125 psig] [] **psig** and hydrostatically tested at 50% excess of the working pressure. Sidesheet height shall be designed to allow a minimum freeboard space at 50% of the mineral bed depth for adequate expansion during backwashing. Tanks shall be equipped with a port on the top of the tank for filling.

2. The softener tank shall be black steel, nominal [] inch diameter by [] inch sideshell. Softener tanks shall be blasted to bare metal and then the tank interior shall be coated with Plasite 7133 epoxy and the tank exterior shall be prime coated and finish painted in a "Safety Blue" enamel. The tank shall be provided with a 5 year extended tank warranty.
- E. Distribution System: Upper and lower distribution systems shall be provided. The upper distribution system shall be of the single point baffle type, constructed of Schedule 40 galvanized steel and fittings. The lower distribution system shall be a PVC hub and radial arm type, constructed with individual fine slotted non-clogging polyethylene strainers arranged for even flow distribution through the resin bed. The lower distribution system shall be embedded in a single layer subfill of washed 1/8" x 1/16" gravel to support the resin bed.
- F. Brining System:
 1. The brining system shall be a []" diameter x []" high, [] pound capacity brine tank. The brine tank and cover shall be molded of corrosion-free fiberglass reinforced phenolic resin with a minimum thickness capable of containing the brine and salt.
 2. A brine regeneration system shall be provided which shall automatically introduce brine into the softeners, close to prevent the entrance of air and refill the brine tank with the proper amount of make-up water. The brine tank shall be equipped with a float operated shut-off to measure the proper amount of make-up water into the brine tank and prevent brine tank overflow.
- G. Valves and Piping:
 1. The main operating valves shall be industrial automatic multipoint diaphragm type, slow opening and closing and free of water hammer. The diaphragm assembly shall be fully guided on its perimeter when pressure activated from one position to another to assure a smooth reliable shut-off without sticking. There shall be no contact of dissimilar metals within the valve and no special tools shall be required to service the valve.
 2. The main operating valves shall be manufactured by the manufacturer of the water treatment equipment. Valve shall be equipped with an internal automatic self-adjusting brine injector to draw brine and rinse at a constant rate regardless of water pressure in the range of 30 to 100 psi. Valves shall have a soft water sampling cock.
 3. Inlet and outlet service valves shall provide full flow with minimum pressure drop. All piping shall be galvanized steel or copper. Dielectric couplings shall be provided for all dissimilar metal connections.

[SELECT ONE OF THE FOLLOWING]

- H. **[Regeneration Controls: Regeneration will be controlled by a 7-day time switch which permits regeneration at any time of day or night, any day or every day of the week. It will have provision for individual adjustment of the backwash and brine-rinse cycles and shall operate on 120 volt 60 Hz single phase. The time switch shall be set to allow regeneration to be activated only between midnight and 4 a.m. Regeneration shall be controlled by an electronic sensor so that regeneration shall occur only when required. It shall compensate for both variation of water usage and water hardness without any field adjustment and shall be unaffected by change of temperature of the water supply. An alternator shall be supplied to allow only one unit to be in regeneration or standby at the time while the other unit is in service. This system shall provide a continuous supply of soft water.]**

[OR]

- I. **[Regeneration Controls: Provide a fully integrated programmable microprocessor driven electronic softener controller. Integral multiported pilot valve operators shall be provided for softeners to initiate a backwash/regeneration sequence based on user programmed volume setpoints. The controller shall be provided by the water softener manufacturer.**
 1. **The system shall consist of two softener (media) tanks each having a dedicated flow meter and configured for parallel flow.**

2. **One tank, designated as the primary, will remain on-line at all times. Variation of soft water flow demand shall automatically cause the second tank to change status from standby to on-line and back to standby as needed. When the primary media tank regenerates the second tank in sequence shall become the primary. As each media tank's user programmable volume is reached it shall immediately be taken off-line, regenerated and placed immediately back on-line or standby depending on soft water flow demand. The controls shall be capable of continuously determining the exhaustion rate of each media tank thus automatically avoiding the possibility of simultaneous regeneration. A cumulative volume totalization to eight digits shall be continuously displayed for each unit. This system shall provide a continuous supply of softened water.**
3. **The water meters shall be full chamber disc type having a flow range of [__ - __] gpm with an accuracy of 1.5% over the entire flow range and shall maintain a separate permanent record of the total accumulated gallons passed. A dry electrical contact shall operate during periods of soft water flow to signal the controller which shall be capable of displaying both flow rate and totalization data.]**
- J. Mineral Resin: Each softener shall be provided with approximately [20] [] cubic feet of ion exchange resin, virgin high capacity sulfonated polystyrene type stable over the entire PH range and good resistance to bead fracture from attrition or osmotic shock. Each cubic foot of resin shall be capable of removing 30,000 grains of hardness as calcium carbonate when regenerated with 15 lbs of salt.
- K. Brine Salt: Brine salt for initial system start-up and operation for the first month of operation shall be provided by the equipment supplier.
- L. **[Salt Conservation System: A Bruner Salt-Master or equal salt management system shall be provided to recycle brine and electronically monitor the brine to accurately deliver the exact salt dosage required to soften the raw water entering the system.]**
- M. Water Testing Set: A water testing set shall be furnished to the Owner for conducting a soap hardness test, complete with metal container for wall mounting. Test kit shall have sufficient supplies for one year of test use.
- N. Guarantee: The manufacturer shall guarantee that under actual operating conditions that the following shall be met:
 1. The effluent shall contain no more than 0.3 GPG hardness as determined by soap test.
 2. That the loss of ion exchange resin through attrition during the first 3 years of operation shall not exceed 3% per year.
 3. That the resin shall not be washed out of the system during the service run or backwashing period.
 4. That the turbidity and color that by reason of passing through the softener system, shall not be greater than the incoming water.
 5. The entire water softening system shall be fully guaranteed for one year after substantial completion.
 6. The brine tank shall be guaranteed for 10 years.
 7. The softener tanks shall be prorata guaranteed for 4 years after the one year full warranty.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. General: Installer shall examine the conditions under which the water softeners are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

- A. General: Pipe and install the water softeners as shown on the Drawings and in accordance with the manufacturer's written installation instructions.

- B. Housekeeping Pads: The water softener and adjacent salt storage shall be installed on a reinforced concrete housekeeping pad as specified in Section 23 03 00, "Basic Materials and Methods".

3.3 START-UP, ADJUSTMENTS AND TRAINING:

- A. Startup: System checkout, start-up and adjustment shall be performed by a representative of the equipment manufacturer. Refer to Section 23 05 93, "Operational Test-Adjust-Balance", for additional requirements.
- B. Training: Owner's Operator training in system operation and maintenance procedures shall be performed by a representative of the equipment manufacturer. System Operating and Maintenance Manuals shall be available to the Owner's Operator at the time of operator training. Refer to Section 15002 for additional requirements.
- C. Operating Instructions: A complete set of operation instructions covering the installation, maintenance and operation of the softener system shall be furnished bound in booklet form in the Operating and Maintenance Manuals. Refer to Section 23 01 00 for additional requirements.

3.4 IDENTIFICATION:

- A. Refer to Section 23 03 00, "Basic Materials and Methods", for applicable painting, nameplates, and labeling requirements.

END OF SECTION 22 31 00

SECTION 22 40 00 - FLOOR, AREA AND ROOF DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide floor, area, and roof drains, and drain specialties and cleanouts as specified.
- B. Types: The types of drains and drain specialties required for this project include, but are not limited to:
 - 1. Roof drains.
 - 2. Floor drains.
 - 3. Area drains.
 - 4. Trench drains.
 - 5. Floor sinks.
 - 6. Cleanouts.
 - 7. Hub drains.
 - 8. Trap primers.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable subject to compliance with the requirements of these Specifications:
 - 1. J. R. Smith Manufacturing Company.
 - 2. Wade Division/Tyler Pipe.
 - 3. Zurn Industries, Inc.
 - 4. Josam.
 - 5. Watts Drainage.
 - 6. Mifab.
 - 7. Sioux Chief

1.4 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets of drains and drain specialties clearly indicating all features, options, materials and dimensions.
 - 2. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver drains and drain specialties in factory-fabricated water-resistant wrapping.
- B. Handle drains and drain specialties carefully to avoid damage to material component, enclosure and finish.
- C. Store drains and drain specialties in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 ROOF DRAINS:

- A. General: Provide roof drains suitable for the type of construction and roofing system at the point of application. Provide all drain accessories required for a complete waterproofed installation.
- B. Roof Drain, (RD-): Galvanized cast iron drain body with removable, vandal resistant, galvanized cast iron dome strainer; clamping collar with integral gravel guard; corrosion resistant clamping bolts; underdeck clamp; insulation extension sleeve and roof sump receiver. Contractor to coordinate connection size and exact options required to suit planned installation method.
 - 1. Zurn Model No. ZG-100-G-R-C-EA-VP
 - 2. Jay R. Smith No. 1015-R-C-G-U-CID
- C. Overflow Roof Drain (OD-): Galvanized cast iron drain body with removable, vandal resistant, galvanized cast iron dome strainer; clamping collar with integral gravel guard; corrosion resistant clamping bolts; underdeck clamp; insulation extension sleeve, roof sump receiver and 2" water dam. Contractor to coordinate connection size and exact options required to suit planned installation method.
 - 1. Zurn Model No. No. ZG-100-W2-G-R-C-EA-VP
 - 2. Jay R. Smith No. 1080-E-R-C-G-U-CID

2.2 AREA DRAINS:

- A. General: Provide area drains suitable for the type of construction and finishes at the point of application. Provide all drain accessories required for a complete installation, waterproofed where applicable.
- B. Area Drain, (AD-) Parking Garage, Reinforced Concrete Tee's or Plate Slab: 14" prom deck drain, size as noted on plans, heavy duty galvanized cast iron with heavy duty heelproof traffic grate, underdeck clamp.
 - 1. Zurn Model No. Z-150-C-G
 - 2. Jay R. Smith No. 1410-C-G-HP
- C. Area Drain, (AD-) Parking Garage, Cast-in-place Concrete Slab: Nominal 13" prom deck drain, heavy duty galvanized cast iron with heavy duty traffic grate.
 - 1. Zurn Model No. Z-150-EA-G
 - 2. Jay R. Smith No. 1415-c-g
- D. Area Drain, (AD-) Plaza Levels: 14" prom deck drain, size as noted on plans, heavy duty galvanized cast iron with heavy duty heel-proof traffic grate, underdeck clamp and sump receiver.
 - 1. Zurn Model No. Z-150-R-C-G
 - 2. Jay R. Smith No. 1410-R-C-G-HP.
- E. Overflow Area Drain, (OAD-) Plaza Levels: 14" prom deck drain, size as noted on plans, heavy duty galvanized cast iron with heavy duty heelproof traffic grate, underdeck clamp and extension.
 - 1. Zurn Model No. ZG-150-E-R-C-G
 - 2. Jay R. Smith No. 1410-E-R-C-G-HP
- F. Area Drain, (AD-): Nominal 8" prom deck drain, galvanized cast iron with square grate with flashing clamp and sump receiver.
 - 1. Zurn Model No. Z-158-G-R-C
 - 2. Jay R. Smith No. 1470-R-C-G
- G. Area Drain, (AD-): Galvanized cast iron drain body with removable, vandal resistant, cast iron dome strainer; clamping collar with integral gravel guard, corrosion resistant clamping bolts, underdeck clamp, insulation extension sleeve and roof sump receiver. Contractor to coordinate exact options required to suit planned installation method.
 - 1. Zurn Model No. ZC-100-EA-R-G-VP
 - 2. Jay R. Smith No. 1015-R-C-CID-U

- H. Overflow Area Drain (OAD-_____): Galvanized cast iron drain body with removable, vandal resistant, cast iron dome strainer, clamping collar with integral gravel guard, corrosion resistant clamping bolts, underdeck clamp, insulation extension sleeve, roof sump receiver and 2" water dam. Contractor to coordinate exact options required to suit planned installation method.

1. Zurn Model No. No. ZC-100-89-EA-R-C-G-VP
2. Jay R. Smith No. 1080-E-R-C-CID-G-U

2.3 FLOOR DRAINS:

- A. General: Provide floor drains suitable for the type of construction and finishes at the point of application. Provide all drain accessories required for a complete installation, waterproofed where applicable.
- B. Floor Drain, (FD-_____) Finished Areas: Cast iron drain and seepage flange, size as noted on Drawings, clamping unit, trap primer tap, and 6" x 6" square adjustable polished nickel bronze strainer type top and deep seal trap.
1. Zurn Model No. ZN-415-6S-[-P]
 2. Jay R. Smith No. 2005-BO6NB-[-P].
- C. Floor Drain, (FD-_____) Mechanical Rooms: Cast iron drain and seepage flange, size as noted on plans, clamping unit, trap primer tap, and [7"] [9"] round adjustable nickel bronze strainer with raised lip and deep seal trap. **Set drain with top of rim flush with finished floor.**
1. Zurn Model No. Z-415-7I or 9I-[-P]
 2. Jay R. Smith No. 3510-F37 or F38 NB-[-P].
- D. Floor Drain, (FD-_____): Cast iron drain and seepage flange, size as noted on drawings, clamping unit, and [_____] " round adjustable nickel bronze strainer type top with funnel converting assembly, deep seal trap.
1. Zurn Model No. Z-415-B-[-P], W/ZN-414
 2. Jay R. Smith No. 2005-ANB-[-P] W/3580-NB
- E. Floor Drain, (FD-_____): 12" x 12" coated cast iron 12" x 12" open top drain, cast iron strainer, **medium duty [half] top grate**.
1. Zurn Model No. Z-566.
 2. Jay R. Smith No. 2633.
- F. Floor Drain, (FD-_____): Cast iron drain and seepage flange, size as noted on Drawings, clamping unit, trap primer tap, nominal 8" round cast iron medium duty grate with nominal 2" center hole, membrane flashing clamps, deep seal trap.
1. Zurn Model No. Z-550-P.
 2. Jay R. Smith No. 2110-P.
- G. Floor Drain, (FD-_____): Cast iron drain and seepage flange, size as noted on Drawings, clamping unit, and trap primer tap, nominal 9" round cast iron heavy duty grate with nominal 2" diameter center hole, membrane flashing clamp, deep seal trap.
1. Zurn Model No. Z-508-P-mod w/2" center hole.
 2. Jay R. Smith No. 2120-P-mod w/2" center hole.
- H. Floor Drain (FD-_____): Cast iron drain and seepage flange, size as noted on Drawings, clamping unit, trap primer tap, nominal 12" round cast iron medium duty grate, membrane flashing clamp, deep seal trap.
1. Zurn Model No. Z-504-P.
 2. Jay R. Smith No. 2130-P.

- I. Floor Drain, (FD-_____): Kitchen floor receptor, cast iron floor drain with integral seepage flange, 12 1/2" sq top, 8" deep or as noted on Drawings, ceiling collar seepage openings and a 6" diameter satin nickel bronze strainer.
 - 1. Jay R. Smith No. 3151-P-22.
 - 2. Josam No. 49040AS-31-P-17.
- J. Floor Drain, (FD-_____): Kitchen floor drain, cast iron floor drain with integral seepage flange, 12 1/2" sq top, 8" deep or size as noted on Drawings, clamping collar, seepage openings, and a 6" diameter nickel bronze funnel strainer.
 - 1. Jay R. Smith No. 3151-P-22.
 - 2. Josam No. 49040AS-31-P-17.
- K. Floor Drain (FD-_____) Central Plant Sump: Sump and grate specified under other Divisions. Drain shall be the same as Roof Drain Type ["RD-_____"]. Contractor to coordinate connection size and exact options required to suit planned installation methods.

2.4 TRENCH DRAINS:

- A. General: Provide trench drains suitable for the type of construction and finishes at the time point of application. Provide all drain accessories required for a complete waterproof installation.
- B. Trench Drain, (TD-_____): Garage trench drain and grate provided under other Divisions. Provide 8" open hub drain set in low point of trench with top of hub flush with bottom of trench.
- C. Trench Drain (TD-_____): Loading dock trench drain and grate specified under other Divisions. Provide 8" diameter roof drain set in low point of trench. Drain shall have galvanized cast iron body, with removable, vandal resistant, galvanized cast iron dome strainer, clamping collar and corrosion resistant clamping bolts. Contractor to coordinate connection size and exact options required to suit planned installation method.
 - 1. Zurn Model No. ZC-125-G-VP
 - 2. Jay R. Smith No. 1330-CID-G-U.
- D. Trench Drain, (TD-_____): Kitchen trench drain, cast iron floor drain with flange, size as noted on Drawings, integral clamping collar and adjustable 5" x 17" rectangular satin nickel bronze top.
 - 1. Wade No. 1103-H17-1.
 - 2. Jay R. Smith No. 2005-S-NB

2.5 FLOOR SINKS:

- A. General: Provide floor sinks suitable for the type of construction and finishes at the point of application. Provide all accessories required for a complete waterproof installation.
- B. Floor Sink, (FS-_____): Square cast iron floor sink with acid resisting enamel interior, seepage flange, aluminum dome strainer and satin nickel bronze half grate. Size as noted on Drawings.
 - 1. Wade No. W-9113-15.
 - 2. Jay R. Smith No. 3199-12
- C. Floor Sink, (FS-_____): Square cast iron floor sink with acid resisting enamel interior, seepage flange, aluminum dome strainer and satin nickel bronze top. Size as noted on Drawings.
 - 1. Wade No. W-9174.
 - 2. Jay R. Smith No. 3200

2.6 CLEANOUTS:

- A. General: Provide cleanouts as shown on the drawings and as required by local ordinance. The size of the cleanouts shall be identical with the size of the soil or waste line in which they are placed for 4" and smaller lines. The size of cleanouts in lines larger than 4" shall be 4" in all cases. Coordinate cleanout

style, mounting, flange, and clamping ring with the construction and finishes where the cleanout is located. Refer to Section 15400, "Plumbing Piping Systems", for additional requirements.

- B. Cleanouts (C.O.) in Finished [and Unfinished] Floors: Adjustable coated cast iron body, brass or bronze countersunk plug, secured round nickel bronze top, Carpet marker for carpeted areas, flangeless, flanged or flanged with clamping ring as required; Zurn No. ZN-1400-VP-BP or Jay R. Smith No. 4033-U (flangeless), No. ZN-1400-KVP-BP or Jay R. Smith No. 4033-F-U (flanged) or No. ZN-1400-KC-VP-BP or Jay R. Smith No. 4033 –FC-U (flanged with clamping ring) or approved equal.
- C. **[Cleanouts (C.O.) in Unfinished Floors: Coated cast iron cleanout ferrule with brass or bronze tapered thread cleanout plug and round smooth stainless steel cover plate; Zurn No. Z-1400-NH or Smith No. 4223 or approved equal.]**
- D. Cleanouts (C.O.) in Finished Walls: Coated cast iron cleanout body with brass or bronze countersunk plug and square smooth nickel bronze cover plate and vandalproof securing screws; Zurn No. ZN-1443-VP-BP or Smith No. 4435-U or approved equal.
- E. Cleanouts (C.O.) in Exterior Lines: Traffic duty, coated cast iron cleanout with brass or bronze tapered thread cleanout plug, nickel bronze top and vandalproof screws. Install in minimum 12" x 12" x 4" concrete pad where not in paving; Zurn No. ZN-1400-HD-VP or Smith No. 4103-U or approved equal.

2.7 HUB DRAINS:

- A. General: Hub drains (H.D.) shall consist of a cast iron soil pipe hub set 2" above floor, unless noted otherwise, and connected to a deep seal P-trap below the floor. Provide a trap primer where noted on the Drawings. Connect to equipment as required.

2.8 TRAP PRIMERS:

- A. General: Provide trap primers to traps where shown on the Drawings: (E.G. TP, FD1TP or FD2TP, etc.), or required by local codes, provide Precision Plumbing Products, Inc., Zurn or an approved equal, trap primers for the traps indicated. Trap primer installation shall include installation a near-by cold water line, isolation valves, and piping to the floor drain to be protected.
 - 1. Zurn Z-1022 Sani-gard Automatic Trap Primer.
 - 2. Sloan F-72-A1 Flush Valve Connection.
 - 3. J.R. Smith Model 2699 Automatic Trap Primer.
- B. Trap Primers shall be installed in all floor drains subject to low or intermittent inlet flow and in all air handling unit rooms which do not have direct connected return air systems.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation: Coordinate flashing work with work of other trades and Architectural details. Coordinate with roofing as necessary to interface roof drains with roofing work.
- B. Setting Locations: Install floor and roof drains in the low points of the surface areas to be drained. Set tops of drains flush with finished floor. Orient drain grates and cleanout covers to parallel floor tile lines where applicable.
- C. Watertightness: Install drain flashing collar or flange so that no leakage occurs between drain and adjoining roofing or flooring. Maintain watertight integrity of penetrated waterproof membranes.
- D. Accessibility: Position drains so that installed drains are accessible and easy to maintain.
- E. Insulation: Refer to Section 23 07 00 for insulation of roof and floor drain bodies.

3.2 COORDINATION:

- A. General: Coordinate the final location of all drains and cleanouts with the aesthetics of construction. Center drains in showers, and other finished spaces, align drains with tile grids and conceal cleanouts in inconspicuous areas.

- B. Notification: Where a cleanout must be located in an exposed area or a drain location cannot be centered in a space or located in the location shown on the Architectural Drawings, notify the Engineer in writing prior to proceeding with the installation.

END OF SECTION 22 40 00

SECTION 22 50 00

FUEL OIL PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide a complete fuel oil supply system including pumps, piping, fittings, valves, controls and accessories as specified and required for a complete and operating system.
- B. Fuel tanks are specified under Section 22 50 10, "Fuel Oil Storage Tanks".
- C. Make all final supply and return connections to equipment furnished under other Sections of the Specifications, as required.

1.3 REFERENCE STANDARDS:

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ANSI B31.1 - Power Piping.
 - 2. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems.
 - 3. ANSI B31.9 - Building Service Piping.
 - 4. API 2000 - Venting Atmospheric and Low Pressure Storage Tanks.
 - 5. ASME Section 9 - Welding and Brazing Qualifications.
 - 6. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 7. ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
 - 8. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
 - 9. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 10. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.
 - 11. ASTM D2996 - Filament-Wound Reinforced Thermosetting Resin Pipe.
 - 12. ASTM D4021 - Glass-Fiber-Reinforced Polyester Underground Petroleum Storage Tanks.
 - 13. NFPA 30 - Flammable and Combustible Liquids Code.

14. NFPA 31 - Installation of Oil Burning Equipment.
15. UL 1316 - Glass-Fiber-Reinforced Plastic Underground Tanks for Petroleum Products.
16. TNRCC, Chapter 334 - Underground and Aboveground Storage Tanks.
17. Conform to applicable EPA, State of Texas and Local Regulations for installation of fuel oil systems.

1.4 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: Provide products complying with these specifications and produced by one of the following:
 1. Glass Fiber Pipe:
 - a. Smith Fiberglass.
 - b. Perm Alert.
 2. Valves:
 - a. Apollo.
 - b. Crane Company.
 - c. Jenkins Bros. Valves.
 - d. Nibco.
 - e. OPW.
 - f. Red and White.
 - g. Stockham Valve and Fittings.
 3. Pumps:
 - a. Red Jacket.
 4. Fuel Gauge/Water Detector:
 - a. Gilbarco.
 - b. Hersey.

1.5 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets of pipe and fittings, valves, pumps, pump controllers, monitoring equipment and other required accessories clearly indicating all features, options, materials and dimensions.
 - 2. Submit complete wiring diagrams for pump controllers and monitoring equipment.
 - 3. Additional information as required in Section 23 01 00.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver fuel oil system components in factory-fabricated water-resistant wrapping.
- B. Handle fuel oil system components carefully to avoid damage to material component, enclosure and finish.
- C. Store fuel oil system components in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS:

- A. Fuel Oil Piping Buried Below Ground:
 - 1. Pipe: Provide ASTM A53, Grade B, Seamless or ERW, Schedule 40 carbon steel or glass fiber reinforced epoxy piping ASTM D2992, filament wound, reinforced, thermosetting epoxy resin piping with threaded and bonded fittings and connections. Pipe shall bear UL label for petroleum products' piping.
 - 2. Adapters: Provide adapters as required for connections to threaded piping.
 - 3. Fittings: Compression molded using epoxy molding compound and bearing the same UL label as pipe for fiberglass and as specified for piping above grade for steel.
 - 4. Secondary Containment: Provide a double wall, secondary containment system over all primary fuel oil piping, consisting of an outer 0.150 inch thick, filament wound FRP containment system with epoxy joints and factory fabricated end fittings as applicable for the proposed installation. At the Contractor's option, all underground piping may be installed in a single secondary containment.
 - 5. Acceptable Product: Smith Fiberglass "Red Thread II", Perm Alert or an approved equal.
 - 6. Adhesives: Provide manufacturers recommended adhesives and curing agents.
- B. Fuel Oil Piping Above Ground:
 - 1. Piping: Black steel ASTM A53, Grade B, seamless, Schedule 40 with threaded ends.
 - 2. Socket Weld Fittings: ANSI B16.11 forged steel socket-weld fittings matching pipe schedule for all non-threaded joints.
 - 3. Threaded Fittings: Malleable iron, [150] [300] psi class, ANSI B16.3 at valves and unions.
 - 4. Refer to Section 23 20 00, "HVAC Piping Systems", for additional requirements.

2.2 VALVES AND ACCESSORIES:

- A. Valves For Fuel Oil Isolation/Balancing Service at or Less Than 200 PSIG:
 - 1. Ball Valves:

- a. Ball valves shall be two piece, full line size (full port) 316 stainless steel balls and stems and reinforced seats and stuffing box rings. All ball valves shall be designed to permit repacking while valve is in line. Valves shall be furnished with blowoutproof stems. Valves used for balancing shall be provided with balancing stops.
 - b. Ball valves 2" and smaller shall be threaded body bronze or brass valves of a full port design. Valves shall be rated for 300 psi WOG and shall conform to Federal Specification WW V 35B. Valves shall be:
 - 1) Apollo No. 70Ä100 Series.
 - 2) Crane No. 9032 Series.
 - 3) Jenkins No. 900ÄT Series.
 - 4) Nibco No. TÄ585 Series.
 - 5) Red and White No. 5044 Series.
 - 6) Stockham No. SÄ204ÄBRÄRÄ2.
2. Check Valves:
- a. Check valves 2" and smaller shall be Class 125 threaded bronze swing check valves with horizontal swing and replaceable discs. Valves shall be rated for 200 psi WOG and shall conform to MSS SPÄ80 and shall be:
 - 1) Crane No. 37.
 - 2) Jenkins No. 92ÄÄ.
 - 3) Lunkenheimer No. 2144.
 - 4) Nibco No. TÄ433.
 - 5) Red and White No. 238.
 - 6) Stockham No. BÄ321.
 - B. Foot Valve: Double poppet with metal-to-metal seat and 8Ämesh screen. Body and poppet shall be bronze; screen shall be brass. Valve rated at 125 psi cold nonshock pressure at 350°F OPW92 or approved equal.
 - C. Strainers: Refer to Section 23 20 00 for requirements.
 - D. [Solenoid Valves: Provide ASCO or approved equal bronze body, two-way solenoid valves rated for 400 psi WOG minimum. Valves shall 120 volt rated coils with Class F insulation and shall be of a normally closed (fail closed) design.]
 - E. [Pressure Regulating Valves: Provide A.W. Cash "B" Series or approved equal pressure regulating valves. Valve shall be iron body, Buna-N diaphragms, and brass piston and cylinder. Valves shall be designed to reduce 120 psi to 20 psi in the fuel oil return line and shall be rated for 150 psi WOG.]

2.3 FUEL OIL PUMPS:

- A. Capacities: Pumps shall deliver the capacities scheduled or shown on the Drawings.
- B. Type: Pumps shall be [submersible] single stage type, bronze fitted, bronze impeller, and stainless steel shaft.
- C. Pressure Rating: Pumps, casings, connections, and mechanical seals shall be rated for operation at the system working pressure.
- D. Design: Pumps shall be UL listed and labeled for installation and operation in a Class 1, Division 1, Group D hazardous location.

2.4 PUMP CONTROL PANEL:

- A. General: Provide a fuel oil pump control panel in a NEMA I wall mounted enclosure. The control panel shall include a NEMA I enclosure, an alternator two lockable disconnect switches, two full

voltage nonreversing motor starters, a control power transformer, pump running lights and manual switches to allow selective operation of each pump. The control panel shall be designed for two individual incoming power circuits. Automatic operation of the pump shall be initiated by a closure of the float switch contact on the generator set day tanks. **[Control panel shall provide 120 volt control via an auxiliary contact in each pump starter to open the respective pump discharge solenoid valve.]** The alternator shall change the lead (running) pump at each operation. All control panel switches and indicators, plus the overall control panel shall have engraved nameplates.

- B. Shutdown: Pumps shall be interlocked to automatically shutdown when a low level is sensed in the main storage tank via a dry contact closure in the fuel level monitoring system.

2.5 TANK LEVEL/WATER MONITOR:

- A. General: Provide an electronic monitoring system to monitor the fuel oil level in the fuel oil storage tank, monitor the tank for leakage and detect the presence and amount of water in the tank with the fuel.
- B. Components: The system shall consist of a printer/control unit, tank probe and interconnecting wiring and the entire system shall be UL listed for fuel oil system use.
- C. Printer/Control Unit: Provide a wall mounted printer/control unit which provides continuous tank leak monitoring when the supplied equipment is not operating, documents pump start and stop times when the supplied equipment is operating and shall provide a low fuel level output to shutdown the fuel oil pumps when a low fuel level is detected. Control unit shall include an integral printer which shall print tank level reports reading tank level in gallons, fuel depth, water depth, and fuel temperature, leak monitor reports, and alarm reports. The control unit shall have dry alarm output contacts for high level, low level and leak detected [and an RS 232C communications port] for monitoring by [_____].
- D. Tank Probes: Provide probes suitable for installation in tank(s) via a 4" riser pipe. Probes shall be temperature compensated to correct for fuel oil temperature variations.
- E. Leak Detection Mode: The monitoring system shall be capable of detecting leakage rates as small as 0.2 gallons per hour.
- F. System: Monitoring system shall be a Gilbarco Tank Monitor 2 Generator Series or an approved equal.

2.6 ACCESSORIES:

- A. Flexible Pipe Connections: Provide full line size flexible connectors at each pump discharge connection **[, at connections to the fuel oil tank vault]** and fuel oil return. All connectors shall be suitable for use at the pressure and temperature encountered at point of operation. End fitting of connectors shall conform to pipe fitting types specified elsewhere. Threaded connections 2" and smaller shall be Amber/Booth Type SS PM metal hose connections constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Minimum lengths shall conform to the following:
 - 1. 1 1/2" diameter (and smaller) x 10" long.
 - 2. 2" x 12" long.
 - 3. 2 1/2" x 13" long.
- B. Fuel Fill Fittings: Provide OPW #633 T/644-TT or equal UL listed fuel fill fittings with a gasketed lockable cap.
- C. Extractor Vent Fitting: Provide OPW #53VM0160 or equal UL listed extractor/vent fittings.
- D. Vent Caps: Provide OPW #63 or approved equal UL listed vent cap fittings with an iron body and 40 mesh brass screen at the fuel oil tank vent line.

- E. Monitor Manholes: Provide H 20 rated steel traffic cover manholes, minimum 14" diameter, with sump for installation of monitoring probes. Sump bottom shall have openings for entry of piping riser with secondary containment and conduit.
- F. Manway Manholes: Provide Neenah or approved equal H 20 rated **[gasketed,]** steel traffic cover manholes, minimum 24" diameter.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Pipe, Valves, and Fittings:
 - 1. Install piping, valves and fittings to make fuel systems complete.
 - 2. Install valves with screwed, flanged or weld ends to match pipe jointing at point of connections.
 - 3. Make change of direction in piping with 90 degree elbows and nipple connections.
 - 4. Pipe shall be clean and free of sand and grease at connection ends.
 - 5. Fiberglass Piping: Install fiberglass piping systems in accordance with the manufacturer's written installation constructions. Pipe shall be tapered, threaded and bonded as required at joint and fittings. Heat shall be applied to ensure proper curing when recommend by the manufacturer. Sleeve piping penetrations through concrete construction. Refer to Section 23 03 00 for additional requirements.
 - 6. Steel Pipe: Ream steel pipe after cutting and before threading or socket welding. All piping system fittings, except at valves and equipment with threaded connections, shall be made using socket welded fittings. Thread with cleancut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make up. Use John Crane, or approved equal, or teflon thread tape applied only to male threads to make up joints. Refer to Sections 23 03 00, 23 20 00 and 23 20 10 for additional requirements.
 - 7. Secondary Containment: Install secondary containment system after piping has been successfully tested.
- B. Fuel Oil Pumps:
 - 1. General: Install pumps where shown, in accordance with manufacturer's written instructions, and recognized industry practices, to ensure that pumps comply with requirements and serve intended purposes. Comply with NEMA standards and requirements of NEC.
 - 2. Pressure Test: Field pressure-test all pumps to 1 1/2 times rated working pressure.
 - 3. Grounding: Provide positive electrical pump and motor grounding in accordance with requirements of the NEC.
- C. Pump Controllers: Install the pump control panel in accordance with the manufacturer's written installation instructions for wiring by Division 26.
- D. Monitoring Systems: Install monitoring systems in accordance with the manufacturer's written installation instructions. Locate monitor panel as shown on the Drawings and provide wiring in empty conduit provided by Division 26. Provide the services of a factory service engineer to checkout, start up, calibrate and certify monitoring systems. Coordinate monitoring panel remote monitoring connections with [_____].

3.2 FIELD QUALITY CONTROL:

- A. Furnish all instruments, equipment, and labor necessary to conduct all tests.
- B. Methods of sampling, inspecting, and testing shall conform to specified standards and codes.
- C. Performance Testing:

1. Prove operation of each pumping control and monitoring system.
2. Should any item or system fail to perform in acceptable manner, adjust, remodel, or replace system or items as required.
3. Repeat performance test, adjust or repair systems or item as often as necessary to prove system and items of equipment in proper and satisfactory operating condition.
4. Refer to Section 23 05 93 for additional testing requirements.

D. Pressure Testing:

1. Before secondary containment fittings are installed and pipe trenches are back filled and with tank vent open, all supply, return, vent and monitor piping shall be pneumatically tested at 150 psi.
2. Maintain pressure for 24 hours without pressure drop.
3. Tanks shall be isolated from lines during testing. Maximum tank test pressure 5 psi.
4. Location of leaks shall be detected by covering all connections with mild soap solution and watching for leaks during pressure tests.
5. To prevent water hammer or over pressurization, do not use quick closing valves and booster pumps without suitable controls.
6. Apply pressure slowly to achieve test pressure and slowly close system.
7. Avoid sudden or excessive pressure surge which could produce failure or whipping action due to sudden release of stored energy.
8. Secondary containment piping shall be pneumatically tested at 25 psi.

E. Furnish equipment manufacturer's qualified representative to monitor and furnish supervisory instructions to ensure proper equipment installation and operation, compliance with warranty requirements, and preparation for system acceptance.

F. Defective Work:

1. If inspection or tests reveal defects, replace or repair defective work or material as necessary.
2. Repeat inspection and tests.
3. Repairs to piping shall be made with new materials.
4. No caulking of screwed joints or holes will be accepted.

G. Certification: Certify that the complete fuel oil and monitoring systems are installed in accordance with all applicable local, state and federal codes, standards and regulations.

3.3 IDENTIFICATION:

A. Refer to Section 23 03 00 for applicable painting, nameplates and labeling requirements.

END OF SECTION 22 50 00

SECTION 22 50 10

FUEL OIL STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide fuel oil storage tanks as specified, scheduled, and indicated.
- B. Types: The types of fuel oil tanks required for the project include, but are not limited to, the following:
 - 1. Underground fuel oil tanks.
 - 2. Fuel oil day tanks.

1.3 QUALITY ASSURANCE:

[EDIT MANUFACTURERS TO SUIT PROJECT]

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
 - 1. Owens/Corning Fiberglas **[FIBERGLASS]**.
 - 2. Xerox **[FIBERGLASS]**.
 - 3. Modern Welding Co., Inc. **[STEEL]**.
 - 4. Buffalo Tank **[Steel/FIBERGLASS]**.
 - 5. Leak-X Corporation.
- B. Manufacturer's Qualifications:
 - 1. Manufacturer of tanks to be reputable firm regularly engaged in design and manufacture of equipment specified.
 - 2. Equipment to be substantially manufactured in manufacturer's own facilities.
 - 3. Equipment furnished to be type that has been commercially available and in satisfactory operation for 5 years minimum.
- C. Regulatory Requirements:
 - 1. Tanks shall be constructed to meet or exceed applicable requirements as set forth for nonmetallic underground flammable liquid storage per following:
 - a. National Fire Protection Association (NFPA):
 - 1) 30, Flammable and Combustible Liquids Code.
 - 2) 31, Standard for Installation of Oil Burning equipment.
 - 3) ASTM Standard document number D4021-81.] **[FIBERGLASS TANKS ONLY]**.

- 4) Tanks shall be UL-certified per UL Standard 52, 142 and 1316, as applicable for storage of flammable liquids and an UL-certification plate shall be attached to each tank.
2. Tanks shall be Factory Mutual approval per FM Standard IM 7A0AF.
3. Equipment and accessories shall meet or exceed applicable federal, state and local requirements for installation and be in conformance with local fire department requirements.
4. Installation shall comply with U.S. Code Title 40 of Federal EPA Clean Water Act to provide Spill Prevention Control Countermeasures, SSPC Plan, for spill catch basin in final grade and paving in proximity to fill pipes.
5. Tank construction shall comply with Federal Law (P.L.) 98-616.
6. Tank installation shall comply with the latest EPA Underground Fuel Oil Storage Act.

1.4 SUBMITTALS:

- A. Shop drawings submittals shall include, but not be limited to, the following:
 1. Tank cut sheets with all features and accessories clearly indicated.
 2. Cut sheets on tank monitoring system, including accessories, options and wiring diagrams.
 3. Certification that tanks are in conformance with all applicable current standards and requirements.
 4. Submit complete wiring diagrams for tank monitoring equipment.
 5. Manufacturer's written tank installation instructions.
 6. Additional information as required in Section 15002.

PART 2 - PRODUCTS

2.1 [UNDERGROUND FIBERGLASS] [VAULT TYPE STEEL] FUEL OIL TANKS:

- A. General: Provide [reinforced polyester underground] [welded carbon steel] fuel oil storage tanks with a primary (internal) tank and a secondary (external) tank. Tanks shall be suitable for [direct burial] [below grade vault installation] as shown on the drawings.
- B. Accessories: Provide all required appurtenances for tanks, [saddles,] taps, manholes, fittings, fill pipes, internal risers, [FRP anchor straps] and monitoring fittings by tank manufacturer for each tank.
- C. Loading Conditions and Design Criteria: Each tank shall meet or exceed the following criteria:
 1. Internal Load:
 - a. Primary and secondary tanks shall withstand [2.5] [5] psi air pressure test with 5:1 safety factor at factory.
 - b. Field pressure test each tank individually again for leakage upon delivery to the site and prior to installation. Test pressures shall be [5] [7] psi.
 2. Vacuum Test: Each tank shall be mercury vacuum tested by tank manufacturer to assure structural integrity. Primary tank shall be tested to 11.5" and secondary tank tested to 9.5" mercury vacuum.
 3. Annular Space: Tank shall have a space between the primary and secondary shell walls to allow for the free flow and containment of all leaked product from the primary tank. Space also allows the insertion of a monitoring device through a monitoring fitting.
 4. Design: Tanks to be designed to support accessories and equipment of standpipes, ladders, fill pipes, manways, fittings, risers, pumps, and similar accessories when installed according to manufacturer's recommendations and limitations.

5. Venting: All tanks shall be vented, such that tanks operate at atmospheric pressure.
6. Design tanks for products to be stored and the pressure and temperature required for the proposed installation.

[FIBERGLASS TANKS ONLY]

7. External Hydrostatic Pressure:
 - a. Buried in ground with 7' of overburden on top of tank.
 - b. Hole fully flooded and safety factor of 7:1 against general buckling.]
8. Surface Loads: When installed according to manufacturer's installation instructions, tanks to withstand surface H-20 axle loads.]
- D. Materials: Tanks (primary and secondary) shall be manufactured with [100% isophthalic polyester resin and glass fiber reinforcement with no sand fillers.] [carbon steel. Tanks shall be sandblasted to a SSPC-6 finish and the outside of the primary tank and the outside and inside of the secondary tank shall be primed during the manufacturer's standard paint system.]
- E. Certification Plate: Permanently affix Underwriters' Laboratories, Inc. label to each tank.
- F. Threaded Fittings - NPT:
 1. Threaded fittings to be material of construction consistent with the requirements of the tank UL label and shall be 4" in diameter half couplings with cast iron plugs and shall include provisions for terminating a secondary containment system where applicable.
 2. Reducers are to be used for smaller sizes where specified and provided with tank.
 3. All threaded fittings to have machine tolerances in accordance with ANSI standard for each fitting size.
 4. NPT fittings to withstand minimum of 150 feet/pounds of torque and 1,000 feet/pounds of bending, both with 2:1 factor of safety.
 5. Fittings shall be provided as required for the project installation.
- G. Lifting Lugs: Provide lifting lugs on tanks capable of withstanding weight of tank with safety factor of 3:1.
- H. Manways:
 1. Provide manways as required and as detailed on the Drawings.
 2. All manways to be flanged and **[22"] [24"]** I.D. complete with UL-listed gaskets, bolts, and covers.
 3. Each steel manway cover shall have three 4" NPT fittings welded in place, in locations as required to suit project piping.
- I. Piping Sumps:
 1. Provide piping sumps for installation above **[manways] [tank openings]** as shown on the Drawings.
 2. Piping sumps shall be **[two piece isophthalic polyester fiberglass and drilled for bolting to manway flange.] [carbon steel and welded to the tank shell.]**

[FIBERGLASS TANKS ONLY]

3. Sump cover shall be an FRP manway with a steel cover, gasket and hardware.]
4. Sump shall be provided with lifting handles, two 4" FRP pipe couplings, four one inch (1") NPT couplings, gasket, mounting hardware and sensor mounting bracket.]

- J. Ladders: Provide [manufacturers standard ladder inside tank at one manway] [a hot dip galvanized vault access ladder end cage] as detailed or required.
- K. Monitoring System:
1. Provide a Leak-X or approved equal continuously monitoring leak detection system capable of detecting the presence of hydrocarbon, water or liquid in the dry annulus space of each double wall tank[, **in the tank vault sump**] and in each piping sump.
 2. The monitoring system shall be approved for intrinsic safety in hazardous locations, and shall be FM-approved or UL-listed. The equipment shall be installed in accordance with NEC, federal, state and local codes.
 3. The system shall consist of a controller designed to display the normal or dry condition of the monitored spaces and alarm with both audible and visual indications when liquid is detected by a continuous monitoring sensor. Power requirements for the controller shall be 120 volt ac, 60 Hz. Where the controller is exposed to the environment it shall have a NEMA 4 rating. The controller shall include a dry alarm output contact for remote monitoring by [_____].
 4. The system annulus sensors shall be designed to be installed into the double wall tanks annulus space. The sensor shall be designed for Class I, Division I, Group D hazardous locations.
 5. The system piping sensors for the piping sump shall be designed to be installed in the tank attached manway piping sump and be capable of detecting the presence of hydrocarbon, water or other liquids that may enter the sump. The sensor shall be designed for Class I, Division I, Group D hazardous locations if required.
 6. The continuous monitoring system shall be designed to detect and alarm within 5 minutes after the sensors come into contact with the liquids being monitored.
 7. The materials supplied shall be corrosion resistant to the materials being stored and not be corrosive to the materials of construction in the **[FRP] [carbon steel]** tank. The system shall consist of a controller, sensors, connecting cables and all necessary materials needed for installation into the tank and its appurtenances.
- L. Warranty: Tanks shall be provided with the manufacturers standard one year materials and workmanship and **[30] [20]** year leak warranty.
- M. Monitor Fittings: Tank shall have a minimum two test monitor fittings, consisting of 4" NPT fittings directly above the secondary tank.

[FIBERGLASS TANKS ONLY]

- N. Anchor Straps: Provide fiberglass-reinforced plastic anchor straps for each tank. Number and location of straps to be as recommended by tank manufacturer and shall be capable of withstanding the installed tank buoyancy load.]

[STEEL TANKS ONLY]

- O. Tank Saddles: Provided welded steel support saddles for each tank. Number and location of saddles to be as recommended by the tank manufacturer and shall be capable of supporting the installed tank load.]
- P. Nameplate and Labels: Affix non-corrosive nameplate showing manufacturer's name, address, identifying model number, serial number, fluid, size, capacity, and other pertinent data.

2.2 FUEL OIL DAY TANKS:

[Insert text as required]

PART 3 - EXECUTION

3.0 INSTALLATION:

- A. Install tanks and accessories in accordance with manufacturer's written installation instructions and all applicable codes, standards, and regulations.
- B. Install [pumps,] [connections,] fittings, fill pipes and vents as detailed on the Drawings and required for each tank.
- C. Install monitoring system per manufacturer's written installation instructions. Locate monitor panel as shown on the Drawings and provide wiring in empty conduit provided by Division 16. Provide the services of a factory Service Engineer to checkout, start-up, calibrate and certify monitoring systems. Coordinate monitoring panel remote monitoring connections with [_____].

3.1 FIELD QUALITY CONTROL:

- A. Testing: Check each individual tank system after installation for satisfactory performance and leak-free operation as recommended by the manufacturer and required by applicable current codes, standards and regulations. Minimum testing shall include pressure testing primary and secondary tanks at 5 psi with pressure gauge and soap solution on tank fittings for one hour with no detectable leakage.
- B. Certification: Certify that the complete fuel oil storage tank and monitoring systems are installed in accordance with all applicable current local, state and federal codes, standards and regulations.

3.2 ADJUSTMENT AND CLEANING:

- A. Clean loose [**resins,**] dirt, dust, and mandrel coatings from inside of tanks prior to filling.
- B. Verify interior of tank is dirt and dust-free prior to filling tanks.

3.3 DIESEL FUEL:

- A. General: Provide all diesel fuel required for generator testing and to fill tank(s) at the time of project acceptance.

END OF SECTION 22 50 10

SECTION 22 60 00

COMPRESSED AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 SCOPE OF WORK:

- A. Work Included: Provide all labor, materials, equipment, tools and services, and perform all operations required in connection with or properly incidental to the construction of complete compressed air system to serve equipment and air outlets as indicated on the Drawings, and as required for a complete and functional system.

1.3 QUALITY ASSURANCE:

[EDIT TO SUIT PROJECT]

- A. Acceptable Manufacturers: Provide products complying with these specifications and produced by one of the following:

- 1. Galvanized Steel Pipe: Provide pipe manufactured by one of the manufacturer's listed in the latest edition of the American Petroleum Institute (API) approved manufacturer listing. **[All pipe shall be domestically manufactured] [all foreign pipe shall be clearly indicated on the pipe submittal and shall include documentation of compliance with applicable ASTM and ANSI standards].**

1.4 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets of compressed air pipe, valves, fittings and other required accessories clearly indicating all features, options, materials and dimensions.
 - 2. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver compressed air piping system components in factory-fabricated water-resistant wrapping.
- B. Handle compressed air piping system components carefully to avoid damage to material component, enclosure and finish.
- C. Store compressed air piping system components in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 COMPRESSED AIR PIPE AND FITTINGS:

- A. Piping: All compressed air piping above grade shall be Schedule 40 galvanized steel pipe conforming to ASTM A-120 and ANSI B36.20. Underground air piping shall be Type 'K' soft drawn copper and shall not have any fittings installed in concealed locations. Piping shall be protected as specified in Section 22 00 00 for underground domestic water piping.
- B. Fittings: Piping 2" and smaller shall be joined using Class 150 galvanized threaded fittings (ANSI B16.3). Thread sealing tape shall be used in all threaded connections. Copper pipe fittings shall be wrought copper brazed end fittings assembled using 95/5 tin-antimony or tin-silver solder.

2.2 VALVES AND TRIM:

- A. Ball Valves:
 - 1. Ball valves shall be tow piece, full line size (full port) **[chromium plated brass] [316 stainless steel] balls [and stems] [, brass stems]** and reinforced seats and stuffing box rings. All ball

valves shall be designed to permit repacking while valve is in line. Valves shall be furnished with blowout proof stems.

2. Ball valves 2" and smaller shall be threaded body bronze or brass valves of a **[full] [standard]** port design. Valves shall be rated for 300 psi WOG and shall conform to Federal Specification WW-V-35B. Valves shall be:
 - a. Apollo No. 77-100 Series **[standard port]**.
 - b. Crane No. 9032 Series **[standard port]**.
 - c. Nibco No. T-585 Series **[full port]**.
 - d. Red and White No. 5044 Series **[full port]**.
 - e. Stockham No. S-216-BR-R-T **[standard port]**.
 - f. Victaulic Style 722 [standard port].

- B. Quick Connect Outlets: Provide brass quick connect fittings and ball valves at all air outlet locations. Provide a matching hose side quick connect fitting at each air outlet.

2.3 HANGERS AND SUPPORTS:

- A. General: Refer to Sections 23 03 00 and 22 00 00 for hanger and support requirements. Compressed air piping shall be supported as specified for domestic water piping.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: All piping, fittings and accessories shall be installed in strict accordance with the industry standard practice and applicable codes.
- B. Pipe Slope: Slope all main piping to valved drain points.
- C. Taps: Air drops from main piping shall rise vertically off of the main and then turn down so as to limit moisture carryover to the air drops. Mains shall be sloped 1/4" per 10 feet to drain legs with a valve and hose connection at the bottom of each drain leg.
- D. Valves: Provide isolation (ball) valves in each tap from the system main and at each air outlet, equipment connection, at the base of each riser and at system drain points.
- E. Buried Piping: Excavation and backfill for buried piping shall be as specified in Sections 23 03 00 and 22 00 00. Pipe shall be protected as specified in Section 22 00 00 for underground domestic water piping. Fittings shall not be installed in underground piping.
- F. Equipment: Air lines routed to equipment furnished by other trades shall be extended to the equipment connection point and provided with a ball valve and suitable union (dielectric if dissimilar metals are involved). Coordinate final air connections to equipment with the installing trade.
- G. Hangers and Supports: The entire piping system and related hangers and supports shall be installed such that the piping system is properly aligned and free of stress. Refer to Sections 23 03 00 and 22 00 00 for additional requirements.

3.2 TESTING:

- A. Test compressed air piping as specified in Sections 23 05 93 and 22 00 00.

3.3 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplate and labeling requirements.

END OF SECTION 22 60 00

SECTION 22 70 00

DI WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

1.2 SCOPE OF WORK:

- A. Work Included: Provide all labor, materials, equipment, tools and services, and perform all operations required in connection with or properly incidental to the construction of a complete **[and fully recirculated]** deionized water distribution system with outlets as indicated on the Drawings, as required for a complete and functional system and capable of delivering **[]** Megohm deionized treated water to locations shown on the drawings. **[All treated water piping shall be circulated to the point of the wall stub-out to serve treated water faucets and equipment.]**

1.3 QUALITY ASSURANCE:

[EDIT TO SUIT PROJECT]

- A. Acceptable Manufacturers: Provide products complying with these specifications and produced by one of the following. All piping system products shall be provided by one manufacturer.

- 1. Polyvinyl Chloride (PVC) and Fittings:

- a. Corr Tech, Incorporated.
 - b. Plastic Piping Systems (PPS).

- 2. Polypropylene (PP) Pipe and Fittings:

- a. Corr Tech, Incorporated.
 - b. GSR Sloan.
 - c. Plastic Piping Systems (PPS).

- 3. Polyvinylidene Fluoride (PVDF) Pipe and Fittings:

- a. Corr Tech, Incorporated.
 - b. Plastic Piping Systems (PPS).

- 4. Treated Water Faucets:

- a. Corr Tech, Incorporated.
 - b. Plastic Piping Systems (PPS).

1.4 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets of treated water pipe, valves, faucets, fittings and other required accessories clearly indicating all features, options, materials and dimensions.
 - 2. Additional information as required in Section 23 01 00.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver treated water piping system components in factory-fabricated water-resistant wrapping.
- B. Handle treated water piping system components carefully to avoid damage to material component, enclosure and finish.
- C. Store treated water piping system components in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 TREATED WATER PIPE, FITTINGS AND VALVES:

- A. Pipe and Fittings: Pipe and fittings shall be **[Schedule 80 Polyvinyl Chloride (PVC) conforming to ASTM D-1785, Type 1 (normal impact), Grade 1 (high chemical resistance) with solvent welded ASTM D-2467 fittings.] [Schedule 80 natural polypropylene pipe conforming to ASTM D-2146 for Type II copolymer, cell class 2690B with Fuseal fittings.] [SYGEF or approved equal 100% pure virgin natural PVDF polymer piping and heat fusion welded fittings.]** Connections at valves and other serviceable devices shall be threaded. All pipe and fittings shall be rated for a minimum of **[150] [232]** psi at 73°F.
- B. Valves: Valves shall be ball type and manufactured of the same material as fittings to assure compatibility. All ball valves shall have Viton seals and PTFE seats. Ball valves shall have a pressure rating of **[150] [225]** psi at 68°F and shall be a true union design.
- C. Flow Control Valves: Provide a 3/8" flow control valve in each and every **[Type TW-1]** treated water outlet that limits the flow to 1/2 GPM and shall furnish and install a 4 GPM flow control valve in each treated water connection to washers. Flow control valves shall maintain a constant flow regardless of inlet pressure changes between 15 and 100 psig. No metal shall be in contact with the liquid. Flow control valves shall be as manufactured by Continental Water Conditioning Corporation or an approved equal and shall be constructed of the same material as the piping system in which they are installed.
- D. Pressure Regulating Valves: Provide, where shown on the Drawings, pressure regulator valves, utilizing the no lube design as manufactured by R-K Industries, of Ontario, CA. Valves shall be constructed of the same material as the piping system in which they are installed. Regulators shall be Model "NLF", no lube fluid pressure with adjustable screw and locknut. Units shall have a teflon diaphragm and shall have no metallic contact with the fluid regulated and shall be of the entry design for inline maintenance.
- E. Pressure Gages: Treated water system pressure gages shall be 4" diameter with 316 stainless steel bourdon tubes and provide a readout of 6 to **[100] [250]** psi. Gages installed in pipe shall be supplied with standard polypropylene body, Teflon diaphragm, liquid filled gage guards. Treated water system pressure gage guards shall be manufactured by PLAST-O-MATIC or an approved equal.

2.2 HANGERS AND SUPPORTS:

- A. Horizontal Piping: All horizontal piping shall be supported on clevis type hangers as specified in Sections 23 03 00 and 22 00 00. Piping supports shall include "U" shaped galvanized sheetmetal trays/shields spanning between hangers and supports to continuously support piping and prevent sagging. Non-metallic piping system hangers and supports shall be provided on maximum 5 foot centers.
- B. Vertical/Riser Piping: All vertical/riser piping shall be supported using riser clamps as specified in Sections 23 03 00 and 22 00 00.
- C. Wall Chase Piping: All wall chase piping shall be supported using the wall/chase support system specified in Section 22 00 00.

2.3 DEIONIZED WATER SOURCE:

- A. **[General: Refer to Section 22 13 13 for water treatment equipment.]**

[OR]

- B. **[General: The deionized water system shall be located in the [], where shown on the drawings, and the entire system, including connections to piping stub-outs provided under this contract and system balancing shall be provided under a separate contract.]**

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: All piping, fittings, hangers, connections and accessories shall be installed in strict accordance with the manufacturer's written installation instructions and applicable codes. Air chambers and shokstops shall not be used on treated water systems.
- B. Damaged Piping: Any damaged piping shall be removed and replaced at the Contractors expense.

[SELECT ONE OF THE FOLLOWING]

- C. **[Fusion Joints: Piping joints and connections shall be made using socket type fittings and the manufacturer's interference fit fusion joint system. Pipe shall be cut and chanfered using the manufacturer's recommended tools, methods and requirements and pipe ends and fitting sockets shall be thoroughly cleaned using isopropyl alcohol or acetone and clean absorbent paper or cloth, prior to joining joints shall be fused using the manufacturer's recommended fusion tools, heater bushings and Tempil sticks and strictly following the manufacturer's recommended fusion procedure.]**

[OR]

- D. **[Solvent Welded Joints: Piping joints shall be made using socket welded fusion joints made per the manufacturer's written joining instructions.]**
- E. Expansion Provisions: All piping systems shall be installed with adequate provisions taken where the installation temperature is outside the range of 65°F to 85°F. Vertical expansion joint assemblies, offsets and restrain as recommended by the piping system manufacturer shall be provided wherever the installation temperature is more than 10°F different from the normal water temperature.
- F. Hangers and Supports: The entire piping system and related hangers and supports shall be installed such that the piping system is properly aligned and free of stress.
1. Vertical stacks shall be supported at each floor using riser clamps. The lowest riser support shall be located below the lowest coupling/hub on the stack and shall restrict sideways as well as downward motion.
 2. Horizontal piping shall be supported using Clevis type hangers with maximum 5'0" hanger spacing.
 3. Piping supports shall include "U" shaped galvanized sheetmetal trays/shields spanning between hangers and supports to continuously support piping and prevent sagging. Non-metallic piping system hangers and supports shall be provided on maximum 5 foot centers.
 4. **[Hangers shall also be located at each offset, bend or fitting.]**
- G. **[Training: The Contractor shall instruct the Owner's maintenance staff the proper procedure for fusing pipe joints and shall provide the Owner with all special tools and fusing equipment required to properly fuse pipe joints.]**

3.2 TESTING AND BALANCING:

- A. Test treated water piping as specified in Sections 23 05 93 and 22 00 00 for domestic water piping.
- B. After installation the Contractor shall **[sterilize the entire piping system using low pressure steam (PVDF systems only)]** and shall flush the entire system with treated water to obtain delivered water quality acceptable to the Owner.

- C. Balance the flow in each leg of the treated water system to assure equal recirculation volumes in each leg of the treated water distribution system.

3.3 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplate and labeling requirements.

END OF SECTION 22 70 00

SECTION 22 80 00

ANIMAL WATERING SYSTEM

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Automated water distribution system.
 - 2. Pressure reducing stations.
 - 3. Automatic flush system.
 - 4. Chlори-flush station.
 - 5. Portable Sanitizer.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each component and item of equipment specified. Include component dimensions, configurations, construction details, joint details, and utility service requirements and locations.
- B. Shop Drawings: Provide large scale plans and elevations of system. Indicate relation of units to surrounding walls, doors and other building components. Provide rough-in plan drawings for coordination with trades.
- C. Provide operation and maintenance manuals with full parts and distribution centers, factory trained and authorized dealers, schematics on processors and sensor modules.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Animal watering system shall be manufactured and installed by a single supplier.
- B. Manufacturer's Qualifications: Five years or more experience in manufacturer of animal room watering systems.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect equipment from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.
- B. Protect equipment throughout construction period.

1.6 PROJECT CONDITIONS

- A. Do not deliver or install equipment until the following conditions have been met:
 - 1. Windows and doors are installed and the building is secure and weather tight.
 - 2. Ceiling, overhead ductwork and lighting are installed.
- B. The Contractor shall be responsible for any alterations to mechanical or electrical service, shown on the Construction Drawings or indicated in these Specifications, necessary to accommodate the manufacturer's product requirements.

1.7 WARRANTY

- A. All equipment furnished under this Section of the Specifications shall be guaranteed, for a period of one year from the date of acceptance thereof, against defective materials, design and workmanship. Equipment Manufacturer's warranties shall be made to the benefit of the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Edstrom Industries, Inc.
819 Bakke Ave.
Waterford, WI 53185-4299
(262) 534-5181
- B. No substitutions will be allowed.

2.2 STAINLESS STEEL ROOM DISTRIBUTION SYSTEM

A. General

The stainless steel room distribution system is a water delivery piping system designed specifically for an animal automated drinking water system. The system operates normally at a low pressure of 3-5 psi, but is subjected to flushing pressures up to 50 psi.

1. The stainless steel room distribution system is a water delivery piping system designed specifically for an animal automated drinking water system. The system operates normally at a low pressure of 3-5 psi, but is subjected to flushing pressures up to 50 psi.
2. This specification applies to the receiving, handling, storage, and installation of stainless steel tubing and fittings for an animal drinking water system.
3. Furnish all materials in accordance with this specification and manufacture in accordance with applicable codes and standards.
 - a. ANSI/ASTM Standard A450 stainless steel tubing.
4. Purchase the complete piping system from a single manufacturer. Factory cut and fabricate tubing to system designed lengths, electropolish and passivate and then cap and/or seal in a bag and suitably box for shipping protection. Individually bag each fitting and suitably box for shipping protection.
5. Inspect shipping cartons upon delivery for damage and material cleanliness. Report promptly to the manufacturer any damaged material.
6. Handle tubing to avoid bending or damage. Keep materials clean and free from grease and oil. Store all tubing and fittings in their original package until ready to use.
7. Store all system material in an area segregated from other construction material. Choose a location inside a building protected from any corrosive atmosphere. Limit access to protect against physical damage, loss and contamination.

B. PRODUCTS

1. Room Distribution piping and fittings

Distributes water from a pressure reducing station into and around each animal room and to flush drain points. Pressure rating is 200 psi minimum. Use piping/fitting design to allow mechanical dismantling for repair or replacement of individual

components. Soldered, brazed or adhesive bonded joints are not permitted. Electropolish externally and passivate all water contact surfaces to attain a uniform oxide inactive surface film.

- a. Stainless steel welded tubing
 - 1) .50" OD x .035" wall
 - 2) 316 L grade
- b. Electropolish/passivation process
 - 1) Electropolish in 135°F solution of 65% phosphoric - 35% sulfuric acid
 - 2) Passivate in 105°F solution of 20% nitric - 80% water
 - 3) Final rinse with 125°F Reverse Osmosis water to remove all chemical residues
 - 4) Electropolish and passivate after all fabrication and welding
- c. Coupling, elbow, tee fittings
 - 1) Clean Fitting or equivalent sanitary type
 - 2) 316 L grade stainless steel
 - 3) ID: .43" to exactly match tubing ID
 - 4) Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all water contact surfaces
 - 5) Joint Seal
 - a) High grade FDA approved silicone
 - b) Seal edge width: .05"
 - c) ID: .43" for flush internal joint
 - d) Ferrule: 316 Stainless Steel
 - e) Retainer hex nut: 303 stainless steel
- d. Interconnect Station (I/C) Assembly
 - 1) Prefabricated piping assembly with a Quick Disconnect (QD)/half coupling fitting welded to one end
 - 2) Clean Fitting connection or equivalent sanitary type
 - 3) QD Type: Industry Standard 1/4" universal style socket
 - 4) Design characteristics in accordance with 2.1.3 with base fitting of QD welded at branch port
 - 5) QD base fitting
 - a) 316 L grade stainless steel
 - b) Fitting length of 1.03" from tubing ID to QD seal
 - 6) QD components
 - a) 316 grade stainless steel
 - b) Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all machined water contact surfaces

- c) QD Seal: High grade FDA approved silicone
 - 7) Debur open end of pipe to make it Clean Fitting ready for field assembly
- e. Pipe/Coupler Assembly
 - 1) Prefabricated piping assembly with a half coupling fitting welded to one end
 - 2) Clean Fitting connection or equivalent sanitary type
 - 3) Design characteristics in accordance with 2.1.3
 - 4) Debur open end of pipe to make it Clean Fitting ready for field assembly
- 2. Interconnect station (I/C)

Located in each animal room as shown on drawings and/or to adequately accommodate manifold connection for mobile or stationary racks or kennel/pen arrangements.

 - a. I/C Connection: Edstrom I/C Assembly with universal style QD socket for hose connection
 - b. Use Pipe/Coupler assembly for all piping runs not requiring I/C connections.
- 3. Detachable Kynar recoil hose

Animal rack water supply hose assembly which can be detached from the room piping for sanitization or during periods of non-use.

 - a. Tubing coil: Black PVDF (Kynar) (3/8" OD x 1/4" ID, NSF standard 61, FDA grade, chlorine tolerance of .5 to 50 ppm)
 - b. Extended Reach: 6 feet
 - c. Autoclavability: Maximum temperature of 250°F
 - d. Quick disconnect couplings - Universal style
 - 1) QD plug on upper end
 - 2) QD socket on lower end
 - 3) 316 grade stainless steel
 - 4) Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all machined water contact surfaces
 - 5) QD Seal: High grade FDA approved silicone
 - 6) Push lock barb connection
 - e. Stainless steel spring supports (3" long) both ends.
- 4. Detachable Primate Hose

Animal rack water supply hose assembly which can be detached from the room piping for sanitization or during periods of non-use.

 - a. Tubing: Black PVDF (Kynar) (3/8" OD x 1/4" ID, NSF standard 61, FDA Grade, chlorine tolerance of .5 to 50 ppm)
 - b. Hose Length: 5'
 - c. Autoclavability: Maximum temperature of 250°F
 - d. Quick disconnect couplings - Universal style

- 1) QD plug on upper end
 - 2) QD socket on lower end
 - 3) 316 Grade stainless steel
 - 4) Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all machined water contact surfaces
 - 5) QD Seal: High grade FDA approved silicone
 - 6) Push lock barb connection
- e. Stainless steel spring wire guard secured to fittings at each end.
5. Detachable Dog Flex Hose

Kennel/pen manifold water supply hose assembly which can be detached from the room piping for sanitization or during periods of non-use

 - a. Tubing: Black PVDF (Kynar) (3/8" OD x 1/4" ID, NSF standard 61, FDA Grade, chlorine tolerance of .5 to 50 ppm)
 - b. Hose Length: As shown on drawing
 - c. Autoclavability: Maximum temperature of 250°F
 - d. Quick disconnect couplings - Universal Style
 - 1) QD plug on upper end
 - 2) QD socket on lower end
 - 3) 316 Grade stainless steel
 - 4) Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all machined water contact surfaces
 - 5) QD Seal: High grade FDA approved silicone
 - 6) Push lock barb connection
 - e. Stainless steel spring supports (3" long) both ends.
6. Solenoid Flush Valve

Solenoid valve located down stream from the water supply rack connection points at the terminating end of each room distribution piping run for Room Distribution Flushing or in the flush drain header at each rack location for On-Line Rack Flushing.

 - a. Body Material: Electro-polished 316 stainless steel
 - b. Input power: 24 VDC, 0.5 amp
 - c. Watertight junction box connection with screw connectors
 - d. Coil: Epoxy encapsulated one piece
 - e. Ports: 3/8" FPT
 - f. Diaphragm: Teflon
7. Rack Flush Recoil Hose

Animal rack flush hose/check valve/fitting assembly that connects the terminating point of the rack manifold to the drain header. QD plug on lower end of hose to plug into supply line/recoil hose QD socket when rack position is vacant.

- a. Tubing coil: Black PVDF (Kynar) (3/8" OD x 1/4" ID, NSF standard 61, FDA grade, chlorine tolerance of .5 to 50 ppm)
- b. Extended Reach: 6 feet
- c. Autoclavability: Maximum temperature of 250°F
- d. Hose Fittings
 - 1) Swivel nut with o-ring seal on upper end
 - 2) QD plug on lower end – Universal style
 - 3) 316 grade stainless steel - wetted parts
 - 4) Push lock barb connection
- e. Stainless steel spring supports (3" long) both ends.
- f. Check Valve
 - 1) Polypropylene body
 - 2) EPDM O-ring seal
 - 3) Stainless steel spring
- 8. Capabilities and Features
 - a. Stainless steel tubing and fittings to be passive in tap water, 10 ppm chlorinated water or 2.5 pH acidified water
 - 1) Edstrom Clean Fitting design provides a consistent, smooth, inside diameter conduit for unobstructed water flow throughout the system piping.
 - 2) Edstrom Clean Fitting seal design assures that no cracks or crevices exist between edge of tubing and mating fitting shoulder when fitting is fully assembled
 - 3) Pocket created by the QD port in the I/C Assembly to be less than 2-1/2 tubing diameters long to allow for water exchange during flushing and to minimize the opportunity for microbial growth

C. EXECUTION

- 1. Perform installation with factory certified technicians on the Clean Fitting system or prequalify/train on-site technicians with factory authorized personnel. Instruct on all aspects of cutting tube, deburring, tube bending and Clean Fitting assembly.
- 2. Fabrication
 - a. Factory debur ends of cut tubing so it is ready to assemble into the Clean Fitting
 - b. Make field cuts with a stainless steel tubing cutter supplied by the system manufacturer and used only on stainless steel and chamfer outside and inside edges per assembly instructions 4230-MI4160 to remove any burrs.
 - c. Make square cuts to accurate lengths and assemble joints tightly.
 - d. Use tube bending whenever possible for corners and offsets with a bender supplied by system manufacturer and used only on stainless steel.
- 3. Installation and Mounting
 - a. Attach tubing to the wall, ceilings or other suitable support structure with 18 GA stainless steel clamps and other appropriate brackets. Use stainless steel mounting hardware.

- b. Provide a 2-hole clamp at each I/C station within 2" of the QD fitting to provide adequate rigidity and support. Provide one-hole clamps at all other mounting points where suitable support can be attained. Space clamps not to exceed 36".
- c. Provide plastic stand-off spacers under each clamp for wall mounting applications to mount piping off the wall by 1/2" with plastic screw anchors and stainless steel self tap screws (#10 x 1-1/4").
- d. Install the entire piping system at a consistent level throughout at a height of 84" to 96" above the floor. Limit any rises and drops.
- e. Provide a stainless steel wall plate on each side of the wall for wall break penetrations. Use silicone sealant to affix the plate to the wall and to make an air tight seal around the pipe. Avoid any mechanical joints inside walls. Do not use wall sleeves.

2.3 PRESSURE REDUCING STATIONS

A. GENERAL

The Pressure Reducing Station is a panel assembly to provide animal drinking water at a normal operating pressure of 3-4 +/-1/2 psi with a minimum flow of one gallon per minute.

- 1. Model 8550 digital display station with auto flush and monitoring sensors.

B. PRODUCTS

1. Enclosure/Panel

All parts shall be constructed of 18 gauge 300 Series Stainless Steel, except back panel of 16 gauge, with commercial satin finish on all exposed surfaces. The two gasketed doors shall have stainless hinges at each side to swing open and provide full access to all components.

- a. Surface Mount Cabinet: 16" H x 25.5" W x 6.5" D
- b. Recessed Back Box: 16" H x 25" W x 6" D
- c. Recessed Door Frame: 17.5" H x 26.5" W

2. Display/Interface Module

Door mounted with digital readout of system pressure and LED Indicators for function status

- a. Enclosure- ABS plastic, water resistant
- b. 3-Character Display with pressure reading in psi, kPa/bar
- c. Signal outputs for digital or network system connections
- d. Output: 24vdc to solenoid valve
- e. Inputs: Pressure transducer, flow switch
- f. LED Indicators: High and low pressure, flow, solenoid power and service
- g. Plug-in cable connectors

3. Wetted Components

- a. Piping, Fittings, Valves, etc.
 - 1) Piping: 1/2" O.D. Tubing- 316L Stainless Steel
 - 2) Fittings: Thread/Clean Joint Compression- 316L Stainless Steel
 - 3) Shut-off Valve: Ball Valve- 316 Stainless Steel

- 4) Flexible Hose: Silicone Hose reinforced with polyester braid
- 5) Inlet Connection: Clean Joint Fitting- 1/2" Tube x 1/2" MPT
- 6) Outlet Connection: Flexible Hose with Clean Joint Fitting for 1/2" Tube
- b. Water Filter- 5" Housing standard (other options available)
 - 1) Housing: Polypropylene with 3/8" FPT ports
 - 2) Replacement Cartridge: 5 micron spun polypropylene
 - 3) Flow Rate: 5 GPM at 50 psi
 - 4) Screen: 50 mesh Stainless Steel (Unfiltered models only)
- c. Pressure Regulator- High flow design
 - 1) Materials- wetted parts
 - a) 316 Stainless Steel
 - b) Diaphragm: Silicone, 6" diameter
 - c) Seat: Silicone
 - 2) Ports: 1/2" MPT inlet, 3/4" MPT outlet
 - 3) Pressure capacity: 75 psi (max) inlet
 - 4) Low Pressure Unit:
 - a) Range: 2-8 psi adjustable outlet
 - b) Standard setting: 3 psi
 - c) Flow rate: 10 GPM @ 3 psi setting
 - 5) High Pressure Unit
 - a) Range: 4-17 psi adjustable outlet
 - b) Standard setting: 15 psi
 - c) Flow rate: 14 GPM @ 10 psi setting
- d. Pressure Transducer (CE Approved)
 - 1) Range: 0-25 psi (0.5% accuracy)
 - 2) 316 Stainless Steel wetted parts
- e. Flow Switch - Non-Adjustable (UL Recognized)
 - 1) Wetted materials: Ryton-R4 and 316 Stainless Steel
 - 2) Flow rate actuation of Switch: 80 +/- 20ml/min.
 - 3) Switch Function: N.O. (normally open with no flow)
 - 4) Switch Rating: SPST .17 amp at 120 Volts AC
- f. Solenoid Valve - Normally closed (UL Listed)
 - 1) Wetted Materials: Electro-polished 316 Stainless Steel Body:
 - 2) Ports: 3/8" FPT
 - 3) Coil: Epoxy encapsulated one piece 24 vdc, .5 amps

2.4 RECOIL HOSE FLUSH STATION

A. GENERAL

The Recoil Hose Flush Station shall be a panel assembled, self-contained unit designed for wall-mounting. It shall provide a method to internally flush up to six Detachable Recoil Hoses at one time. The flushing procedure involves connecting up to six recoil hoses to the Flushing Station and flushing them with water and then evacuating the hoses with compressed air. This may be accomplished manually with Model 2450 or automatically with Model 5480. Periodic flushing may control bacterial growth in the recoil hoses. For more effective bacterial control, the recoil hoses can be chlorine sanitized by installing a separate Chlorine Injector Station (P/N 7130-6574-301 or 302) in the feed water line to the Recoil Hose Flush Station. The auto model is UL LISTED.

1. Model 2450 - Manual Flush Station (P/N 7300-2450-201) with stainless steel ball valves
2. Model 5480 – Automated Flush Station (P/N 7300-5480-301) with GP Controller and stainless steel solenoid valves
3. Approximate overall dimensions: 35" high x 25" wide x 6-1/2" deep

B. DESCRIPTION OF OPERATION

The Recoil Hose Flush Station is designed to flush up to six recoil hoses with water or a sanitizing solution (with separate Chlorine Injector Station) and then evacuate the hoses with compressed air. The Manual Flush Station has ball valves which are turned manually to introduce either water or air. The Automated Flush Station is equipped with a GP Controller with user-settable times which controls two solenoid valves. This permits the flush sequence to be completed by just pushing one button. The GP Controller has both 2-cycle and 4-cycle operation. Two-cycle operation has the capabilities to control the length of a plain water flush and air evacuation. Four-cycle operation is selected when the water supply is chlorinated to sequence through 4 timed steps: initial flush, soak period, second flush, and air evacuation.

1. Operating Parameters
 - a. Water Supply Pressure: 40-60 psi/75 psi maximum
 - b. Water Supply Flow: 4 gpm minimum
 - c. Compressed Air: Clean, oil free
 - d. Compressed Air Pressure: 15-60 psi/75 psi maximum
 - e. Compressed Air Flow: 10 cfm (cubic feet per minute)

C. EQUIPMENT AND COMPONENTS

1. Panel
 - a. Size: Approximately 35" H x 25" W
 - b. Material: 300 series 18 gauge stainless steel with pre-punched holes for mounting screws.
2. Wetted Components
 - a. Piping: 1/2" OD Tubing - 316SS
 - b. Fittings: Thread/Compression Type 316SS
 - c. Check Valves (air and water inlet)
 - 1) Model 2450: 316 Stainless Steel
 - 2) Model 5480: 316 Stainless Steel

- d. Quick Disconnects:
 - 1) Material: 316 Stainless steel (wetted parts only)
 - 2) Style: Universal with ball check in QD plug
- e. Valves:
 - 1) Model 2450: Manually operated Stainless Steel- 90 degree turn ball type.
 - 2) Model 5480: Solenoid operated Stainless Steel 115 VAC 50/60 Hz normally-closed pilot-operated type.
- f. Plumbing Connections:
 - 1) Water/Air Inlet: Flange with swivel nut for 1/2" MPT adaptor
 - 2) Drain: 1/2" OD 316 Stainless Steel Compression fitting with 15' of drain piping.

3. Control Panel (Model 5480 only)

- a. Enclosure: Nema 12, Size 10-1/2" H x 8-1/2" W x 5" D 304 Stainless Steel
- b. Electrical Requirements: 115 VAC, 50/60 Hz, single phase, 1 amp with ground fault interrupter (GFI circuit) required (must be hard wired)
- c. GP Controller Features
 - 1) Start and Reset Buttons
 - 2) 32-character Liquid Crystal Display (LCD)
 - 3) Power and Alarm indicator lights
 - 4) Audible Alarm with Silence Button
 - 5) Keypad with dome switches
 - 6) Selectable 2-cycle and 4-cycle flush modes
 - 7) Cycle settings:

Flush 1:	preset to 2 min, range 1-9 min
Soak (4-cycle only):	preset to 30 min, range 1-99 min
Flush 2 (4-cycle only):	preset to 2 min, range 1-9 min
Air Evacuate:	preset to 15 sec, range 1-99 sec

2.5 CHLORI-FLUSH STATION

A. GENERAL

The Chlори-Flush Station shall be a panel assembled self-contained unit designed for wall mounting. It will provide chlorinated water at an operating pressure of approximately 17 psi for flushing and sanitizing mobile rack manifolds. Both models are UL LISTED.

The flush station shall consist of a metering pump, a 4 gallon tank, a flow switch, an inlet water filter/mixing tube, pressure regulator, wall mount hardware, a poly recoil hose with quick disconnect on the outlet side for connection to the mobile rack watering manifold and a solenoid valve and GP Controller for either 1-cycle or 3-cycle operation.

- 1. Model 2494 - Automated Flush Station with stainless steel solenoid valve and GP Controller, for tapwater or purified water supply (P/N 7310-2494-305)
- 2. Approximate overall dimensions: 40" high by 37" wide by 10" deep.

B. DESCRIPTION OF OPERATION

The Chlори-Flush Station is designed to mix a sodium hypochlorite solution into the water flow. When a rack manifold is connected to the Chlори-Flush Station and water flow is detected by the flow switch, the metering pump will start injecting the chlorine solution. The pump will keep operating until the preset time has elapsed (automatic units) or water flow stops. The sodium hypochlorite solution is held in a 4-gallon polyethylene tank.

The Automated Chlори-Flush Station uses the Edstrom Industries GP Controller to control and monitor both 1-cycle and 3-cycle operation. One-cycle operation controls the length of flush time only. Three-cycle operation sequences through 3 timed steps: initial flush, soak period, and final flush.

1. Operating Parameters

- a. Water Supply Pressure: 25 psi minimum/75 psi maximum
- b. Water Supply Flow: 2 gpm minimum
- c. Water Supply Temperature: 40-120°F (4 - 49°C)
- d. Flush Station Output Pressure: 15-17 psi
- e. Flush Station Output Flow: 0.25 gpm minimum, 1.0 gpm typical
- f. Chlorine Concentration: 20 ppm recommended, adjustable
- g. Flush Cycles per tank: One full tank will treat approximately 720 gallons of water at 20 ppm or 1300 gallons at 10 ppm. This is 180-480 manifold flush cycles depending on flush time and flow rate.

C. EQUIPMENT AND COMPONENTS

1. Panel

- a. Size: Approximately 23.5"H x 35"W
- b. Material: 300 series 18 gauge stainless steel with pre-punched holes for mounting screws.

2. Piping, Fittings, Valves, etc.

- a. Piping: 1/2" OD Tubing-316SS
- b. Fittings: Thread/Compression Type-316SS
- c. Valves: Solenoid operated Stainless Steel 115 VAC 50/60 Hz normally - closed pilot-operated type and stainless steel ball type.
- d. Check Valves: 316 Stainless Steel
- e. Inlet Connection: Flange with swivel nut for 1/2 MPT adaptor

3. Flow Switch

- a. Activation Flow Rate: .25 gallons/minute minimum
- b. Construction: PVC with hermetically sealed switches
- c. Electrical Rating: 115 Volts AC, 50/60 Hz (.50 amps maximum), normally closed

4. Mixing Chamber:

- a. Construction: Polypropylene with 3/8 NPT ports
- b. Mixing Tube: PCV pipe

5. Chlorine Injection Pump/Tank

- a. Construction: Glass fiber reinforced thermoplastic. All exposed fasteners are stainless steel

- b. Flow Rate: Maximum capacity 31 ml/minute, maximum pressure 100 psi
- c. Electrical Rating: 115 volts AC, 50/60 Hz. Ave. input power is 130 watts @ maximum speed
- d. Suction and Injection: A foot valve with integral strainer is provided for the suction line. The injection point has an anti-siphon check valve with 1/2" NPT male connection
- e. Solution Tank: Capacity 4 gallon, Size 12" x 6" x 12", Material Polyethylene
- 6. Pressure Regulator:
 - a. Construction: 316 Stainless steel wetted parts
 - b. Ports: 1/2" MPT inlet, 3/8" MPT outlet
 - c. Pressure Capacity: 75 psi maximum inlet, 17 psi outlet
 - d. Flow at 17 psi - 13 gpm
- 7. Recoil Hose Assembly:
 - a. Hose Material: Polyurethane - 3/8" O.D. by 1/4" ID, black, FDA Grade
 - b. Hose Reach: 10'
 - c. Quick Disconnect: Universal Style stainless steel socket
- 8. Control Panel
 - a. Enclosure: Nema 12, Size 10" x 8" x 6". 304 Stainless Steel.
 - b. Electrical Requirements: 115 volts AC, 50/60 Hz, single phase, 1 amp with ground fault interrupter (GFI circuit) required (must be hard wired)
 - c. Controls:
 - 1) Manual: Selector Switch for Chlorinated Water or Plain Water
 - 2) Automatic: GP Controller features
 - a) Start and Reset Buttons
 - b) 32-Character liquid Crystal Display (LCD)
 - c) Power and Alarm indicator lights
 - d) Audible Alarm with Silence Button
 - e) Keypad with dome switches
 - f) Selectable 1-cycle and 3-cycle flush modes
 - g) Cycle settings

Flush 1:	preset to 2 min, range 1-9 min
Soak (3-cycle only):	preset to 30 min, range 1-99 min
Flush 2 (3-cycle only):	preset to 2 min, range 1-9 min

2.6 CHLORINE INJECTOR STATION

A. GENERAL

The Chlorine Injector Station shall be a panel assembled self-contained unit designed for wall mounting. It will provide chlorinated water for the Edstrom Recoil Hose Flush Station, and other applications where the water flow rate is constant. Both units are UL LISTED

The unit shall include a metering pump, a 4-gallon tank, a flow switch, a mixing chamber, electrical controls and wall mounting hardware. All components shall be compatible with either tap water or purified water supply.

1. Chlorine Injection Station for stand alone operation (P/N: 7130-6574-301)
2. Chlorine Injection Station for use only with auto Recoil Hose Flush Station (P/N 7300-5480-301) with a GP Controller to provide control functions (P/N 7130-6574-302)
3. Approximate overall dimensions: 38" high by 35" wide by 10" deep.

B. DESCRIPTION OF OPERATION

The Chlorine Injector Station is designed to mix a sodium hypochlorite solution into the water flow. When water flow is detected by the flow switch, the metering pump will start injecting the chlorine solution. The pump will keep operating until water flow stops. The sodium hypochlorite solution is stored in a 4 gallon polyethylene tank.

1. Operating Parameters
 - a. Water Supply Pressure:
 - 1) 75 psi maximum
 - 2) Recoil Hose Flushing - 40-60 psi
 - b. Water Supply Flow:
 - 1) 0.25 gpm minimum
 - 2) Recoil Hose Flushing - 4 gpm minimum
 - 3) Water Supply Temperature: 40-120°F
 - c. Chlorine Concentration: 2-20 ppm, adjustable ranges
 - d. Treatment capacity per tank: Half full tank will treat approximately 1350 gallons of water at 20 ppm.

C. EQUIPMENT AND COMPONENTS

1. Panel
 - a. Size: Approximately 23.5" H x 35" W
 - b. Material: 300 series 18 gauge stainless steel with pre-punched holes for mounting screws
2. Piping, Fittings, Valves, etc.
 - a. Piping: 1/2" OD Tubing - 316SS
 - b. Fittings: Thread/Compression Type - 316SS
 - c. Ball Valve: 3/8" FPT - 316SS
 - d. Inlet Connection: Flange with swivel nut for 1/2 MPT adaptor
 - e. Outlet Connection: 1/2 OD compression fitting
3. Flow Switch
 - a. Activation Flow Rate: .25 gallons/minute minimum
 - b. Construction: PVC with hermetically sealed switch
 - c. Electrical Rating: 120 Volts AC, 50/60 Hz, (.5 amps maximum), normally closed.
4. Mixing Chamber

- a. Construction: Polypropylene with 3/8 NPT ports
- b. Mixing Tube: PVC Pipe
- 5. Chlorine Injection Pump/Tank
 - a. Construction: Glass fiber reinforced thermoplastic. All exposed fasteners are stainless steel
 - b. Flow Rate: Maximum capacity 26 ml/minute, maximum pressure 140 psi.
 - c. Electrical Rating: 120 volts AC, 50/60 Hz. Ave. input power is 168 watts @ maximum speed.
 - d. Suction and Injection: A foot valve with integral strainer is provided for the suction line. The injection point has an anti-siphon check valve with 1/2" NPT male connection
 - e. Solution Tank: Capacity 4 gallon, size 12" x 6" x 12", Material - Polyethylene
- 6. Control Panel - Model 301 only
 - a. Enclosure: Nema 12, Size 10" x 8" x 6". 304 Stainless Steel
 - b. Electrical Requirements: 120 Volts AC, 50/60 Hz, single phase, 1 amp with ground fault interrupter (GFI circuit) required (must be hard wired)
 - c. Controls: Selector switch for chlorinated water or plain water
- 7. Junction Box - Model 302 only
 - a. Enclosure: Weatherproof 2-gang switch box. Aluminum
 - b. Electrical requirements: Must be powered from Edstrom GP Controller on auto Recoil Hose Flush Station
 - c. Controls: Must be controlled by Edstrom GP Controller on auto Recoil Hose Flush Station

2.7 AUTOMATED WATERING SYSTEM CONTROLLER

A. GENERAL

The Automated Watering System Controller (AWSC) is a microprocessor based control and monitoring system specifically designed for automated animal drinking water systems and cage pan and animal room trench flushing systems. The system provides a means to simultaneously flush and monitor animal drinking water systems and control trench and cage pan flushing.

B. PRODUCTS

1. Major System Components

a. CONTROLLER

Collect, process, store all data from sensors; store all configuration data, provide user interface to view status, activate controls, and change configuration of all animal drinking water system pressure reducing station sensors, by pass valves and flush valves.

1) Enclosure and display - surface mounted

- a) Surface mount stainless steel enclosure (14"W x 16"H x 6"D)
- b) Recessed stainless steel back box and Flush Mount Panel (16"W x 20"H x 6"D)

- c) 40x2 character liquid crystal display
 - d) 16 key keypad, all poly dome switches
 - e) Input power: 24vac, 1 and 3 amp fused inputs
- 2) Processor and Communications
 - a) 16 bit microprocessor with communications coprocessor
 - b) Non-volatile user program memory
 - c) (64) 24vdc, 0.5amp outputs, fused in banks of 16 to control solenoid valves
 - d) 1 network input to monitor up to 32 pressure reducing stations for pressure and leak
 - e) Auxiliary form C dry remote alarm contact
 - f) RS-232 printer interface
 - g) Audible alarm
 - h) Alarm, service, power LED indicators
- 3) Connections and Cable
 - a) Connection to solenoid valves via 2 conductor 18 gauge shielded cable
 - b) Connection to pressure reducing station interface board via 22 gauge twisted pair network communication cable
 - c) Plug in screw connectors requiring no tools for disassembly
- b. POWER SUPPLY-Provides power to controller, interface modules and solenoid valves.
 - 1) Enclosure - surface mounted
 - a) NEMA 12 painted steel (8"W x 10"H x 6"D)
 - 2) Power input and output
 - a) Input power: 120vac 3 amp fused
 - b) Output power: 24vac 10 amp fused
 - c) Plug in screw connectors requiring no tools for disassembly
 - d) Power on LED indicator
- c. Pressure Reducing Station Interface MODULE- Provides interface from network communications cable to pressure station monitoring sensors and power connection to solenoid valve
 - 1) Enclosure
 - a) ABS plastic water resistant
 - 2) Processor and Communications
 - a) 8 bit microprocessor
 - b) Output: 24vdc to solenoid valve
 - c) Inputs: high pressure switch, low pressure switch, flow switch

- d) LED indicator lights: high and low pressure, flow switch, power and service
 - e) Plug in screw connectors requiring no tools for disassembly
 - d. PRINTER - Remote
 - 1) HP color inkjet
 - 2) Serial to parallel converters with appropriate line drivers
 - e. SPEECH/MODEM ALARM notification and dial in device
 - 1) 33.6 or better modem with voice mail
- 2. MONITORING DEVICES
 - a. Pressure Switch-Monitor animal watering system pressure reducing station for high and low water pressure
 - 1) Materials and ratings
 - a) Wetted materials: 17.7 PH series stainless steel
 - b) Low pressure setting: 1.25 PSI +/- 1/4 PSI
 - c) High pressure setting 7.25 PSI +/- 1/4 PSI
 - d) Contacts open when system pressure between low and high settings
 - e) Rating: SPDT 10 amp at 120 vac
 - 2) Flow Switch-Monitor animal watering system for water flow
 - a) Materials and ratings
 - (1) Wetted materials: polysulfone and 300 series stainless steel
 - (2) Flow rate actuation: 80 ml/min +/- 20 ml/min
 - (3) Rating: normally open SPST 0.17 amp at 120 vac
- 3. CONTROL DEVICES
 - a. Solenoid Valve-Provide bypass to high pressure regulator in pressure reducing station, open to flush watering room distribution systems, individual cage rack flushing systems, trench or cage pan flushing systems
 - 1) Pressure reducing station bypass, room distribution and cage rack flush valves
 - a) Body material: 316 stainless steel
 - b) Input power: 24 vdc 0.5 amp
 - c) Watertight junction box connector with spade or screw connectors
 - d) Coil: epoxy encapsulated one piece
 - e) Ports: 3/8 inch FPT
 - f) Diaphragm: Buna - N
 - 2) Trench and cage pan flush valves
 - a) Wetted material: brass
 - b) Input power: 24 vdc 0.5 amp
 - c) Watertight junction box connector with spade or screw connectors

- d) Coil: epoxy encapsulated one piece
- e) Ports: to match inlet pipe size
- f) Diaphragm: Buna - N

4. CAPABILITIES AND FEATURES

- a. Automated Monitoring and Control of Animal Drinking Water Systems
 - (1) Open sequentially and in combination, pressure reducing station bypass and terminal or individual cage rack solenoid flush valves
 - (2) Allow flushing at only one point at a time
 - (3) Delay closure of terminal flush solenoid valve allowing system to return to normal operating pressure
 - (4) Control system flushing with user defined start times entered at the controller user interface
 - (5) Control flushing of an individual room or cage rack flush solenoid valve at the controller after entering a valid PIN
 - (6) Report and store events at the controller verifying a successful flushing sequence based on data from pressure reducing station pressure and flow sensors
 - (7) Begin alarm notification process when pressure reducing station pressure and flow sensors indicate a flush sequence has failed, or when a high or low pressure or leak condition is sensed
- b. Automated Flushing of Animal Room Trenches and Cage Pans
 - 1) Open sequentially trench or cage pan solenoid flush valves
 - 2) Allow flushing at only one point at a time
 - 3) Control system flushing with user defined interval times entered at the controller user interface
 - 4) Control flushing of an individual trench flush or cage pan flush solenoid valve at the controller after entering a valid PIN
- c. Alarm Notification
 - 1) Activate remote alarm contact during alarm condition
 - 2) Activate controller alarm LED indicator during alarm condition
 - 3) Display alarm condition in status screen, showing location and nature of the alarm
 - 4) Activate audible alarm during alarm condition until silence button is pushed
- d. Data Storage
 - 1) Store all system activity data, including alarm information, flush start and end data, user activity and alarm acknowledge activity in non volatile memory
 - 2) Store all configuration data in non volatile memory
- e. Data Reporting

- 1) Provide printed reports for a user defined date range including all activities and alarm information including date, time and location
- f. User Interface
 - 1) Provide complete and self contained user interface at the controller requiring no additional input devices such as an external computer or replacement of programmed microchips to modify system setup or configuration
 - 2) Provide status screens to display time, date, system status and current alarm conditions
 - 3) Provide activate screens to allow the user, after entry of a valid PIN to activate a flush sequence, flush an individual flush valve, pulse an individual flush valve or activate high pressure at a pressure reducing station and acknowledge alarms
 - 4) Provide configure screens to allow user, after entry of a valid PIN and passcode to add a PIN, delete a PIN, change date and time, activate audible alarm, set sequence times, set flush length, set alarm delays
 - 5) Provide install screens to allow user, after entry of a valid PIN and passcode to add new monitoring and control devices to the system
 - 6) Provide plain English messages and user defined labels for all control and monitoring devices

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine and verify that surfaces of the structure to receive the animal watering system have no defects or errors that would result in poor or potentially defective application or cause latent defects in workmanship.
- B. Report any unsatisfactory conditions to the Architect.
- C. Starting installation shall imply acceptance of surfaces.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's latest published requirements, specifications, details, and approved submittals.

3.3 ADJUSTING

- A. Provide an adequate number of service representatives (minimum of one full time) for the four-week period immediately prior to the occupancy of the facility to adjust and repair any part of the equipment, to ensure proper start-up, smooth operation, and correction of any mechanical failure. The names, addresses and telephone numbers, including both office and residence, of the service representatives assigned to this installation shall be provided at the onset of the specified period.

3.4 DEMONSTRATION

- A. Start-Up Assistance: The Owner will designate one member of the Owner's staff to accompany the service representatives described in 3.3 above.
- B. Operational and Maintenance Training: Provide instruction by factory-trained and certified personnel for a minimum of 6 of the Owner's personnel for a period of not less than 40 hours. The training shall be given at a location designed by the Owner, in addition to any necessary onsite orientation and training. Provide bound copies of training materials for each attendee plus additional copies as required by the contract close-out. The contractor

shall submit a training proposal with program materials, instructors qualifications, and proposed schedule, a minimum of 60 days prior to the training session. The Owner reserves the right of approval of any training course, material, instructor, and schedule.

END OF SECTION 22 80 00